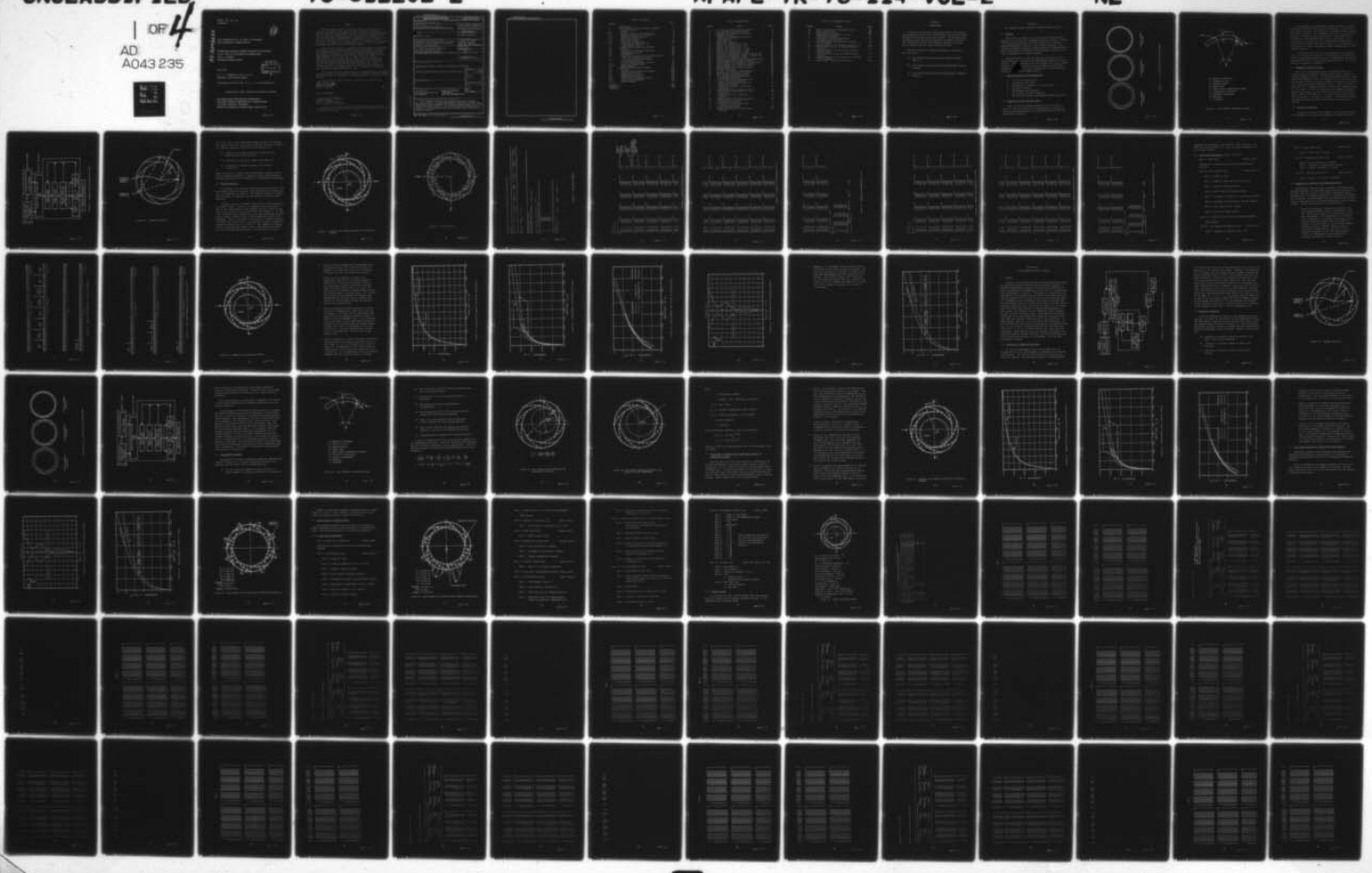
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VOLUME II

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# GAS LUBRICATED FOIL BEARING DEVELOPMENT FOR ADVANCED TURBOMACHINES

AIRESEARCH MANUFACTURING COMPANY OF ARIZONA
A DIVISION OF THE GARRETT CORPORATION
402 S. 36 STREET
PHOENIX ARIZONA 85010

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VOLUME II-ANALYTICAL TOOLS

Final Report for Period 30 JUNE 1973 - 30 NOVEMBER 1976

Approved for public release; distribution unlimited

AIR FORCE AERO PROPULSION LABORATORY
AIR FORCE WRIGHT AERONAUTICAL LABORATORIES
AIR FORCE SYSTEMS COMMAND
WRIGHT-PATTERSON AIR FORCE BASE, OHIO 45433

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This report has been reviewed by the Information Office (ASD/OIP) and is releasable to the National Technical Information Service (NTIS). At NTIS, it will be available to the general public, including foreign nations.

This technical report has been reviewed and is approved for publication.

Ronald D. Dayton

RONALD D. DAYTON
Project Engineer

FOR THE COMMANDER

Howard F. Jones

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20. ABSTRACT (Continue on reverse side if necessary and identify by block number)

This document presents the computer analytical program developed as part of the gas-lubricated foil bearing design and development study conducted by AiResearch Manufacturing Co., under Contract F33615-73-C-2058. The report contains a detailed discussion of the computer program and includes sample problems and program listings.

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# SECTION I

# INTRODUCTION

A method of analytically determining various foil bearing characteristics for the foil thrust bearing and the foil journal bearing were developed during this program. The approach used in developing the analytical programs is discussed in Volume I. This volume presents the three computer programs in Fortran source listing form and a User's Manual for each.

The three programs, discussed separately in Sections II, III, and IV are:

(a) Foil Journal Bearing Elasticity Computer Program "Foils".

(b) Foil Journal Bearing Elasticity/Hydrodynamic Computer Program

(c) Foil Thrust Bearing Elasticity/Hydrodynamics Computer Program



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SECTION II

# FOIL JOURNAL BEARING ELASTICITY COMPUTER PROGRAM "FOILS"

## 2.1 General

The efforts to analyze foil journal bearings required the formation of a specialized nonlinear elasticity solution. Program "Foils" has been developed and forms the basis of a coupled elasto-hydrodynamics solution to foil journal bearings. Rotor dynamics simulation requires accurate prediction of bearing stiffness characteristics; therefore, this nonlinear elasticity solution is presented as a separate program.

Program "Foils" is a static elasticity solution for foil journal bearings. No inertia or hydrodynamics effects are incorporated. However, testing of the foil bearing test rig has demonstrated that the location of critical speeds can be accurately predicted by undamped rotor dynamics model utilizing bearing stiffness predicted by Program "Foils".

## 2.2 Program Limitations and Assumptions

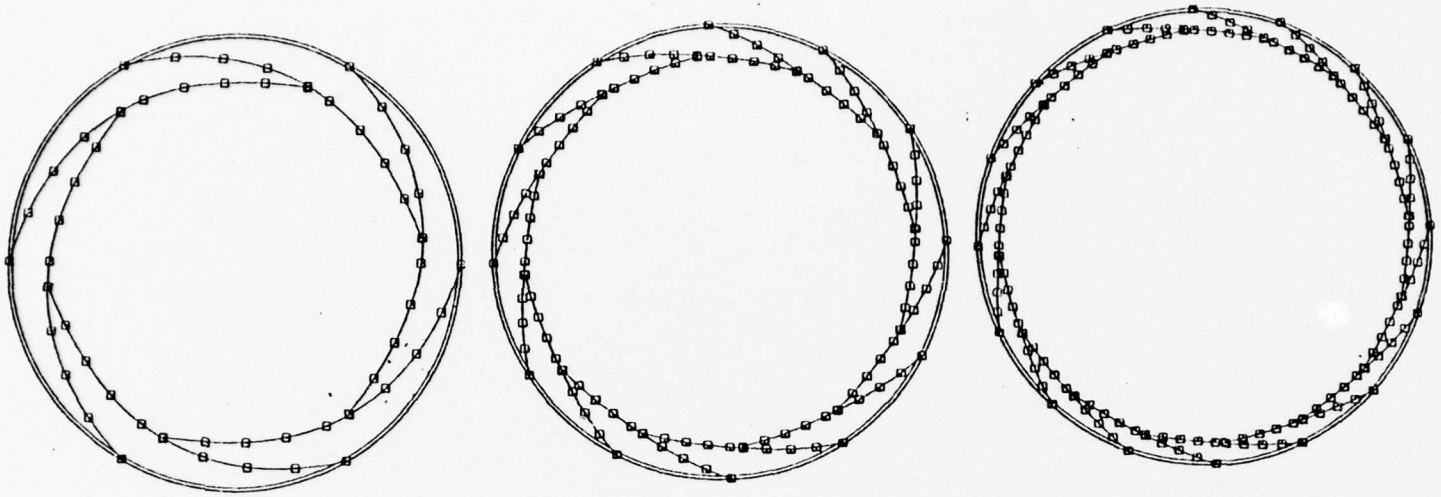
- 6, 8 or 10 nodes per foil
- A maximum of 160 nodes
- The coating is assumed to be nonstructural
- Constant thickness
- Misalignment not permitted
- No frictional effects considered
- The shaft and bearing housing are assumed to be rigid

## 2.3 Theoretical Basis and Flow Chart

Some typical foil bearing geometries are illustrated in Figure 1. The foil elasticity is represented as a series of short curved beam elements with the coordinate system and sign convention of Figure 2.



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6-FOIL ASSEMBLY POSITION

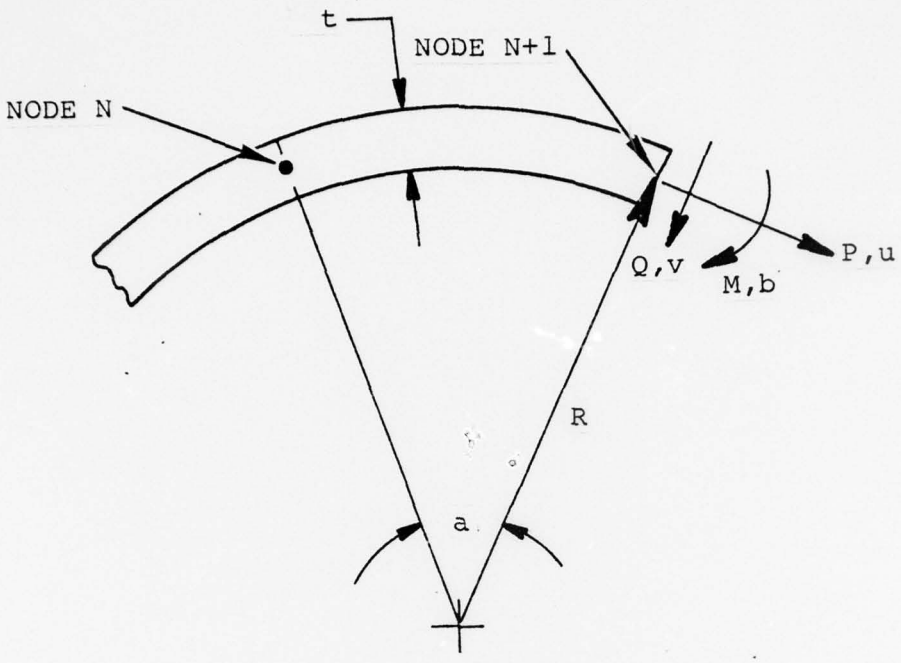
12-FOIL ASSEMBLY POSITION

16-FOIL ASSEMBLY POSITION



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Figure 1. 6, 12, and 16-Foils Configurations.




R = Radius of curvature
P = Tangential load
M = Bending moment
Q = Shear load
a = Angle which subtends the element
u = Tangential displacement
v = Flexure displacement
b = Rotation
t = Thickness

Figure 2. Foil Geometry Coordinate System.



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By application of Castigliano's second theorem, the element and system stiffness matrices may be determined. The solution to the stiffness equation is provided by a straight-forward displacement matrix approach. The attachment of the foil to the bearing housing is assumed to be a "pinned joint". The difficulty in the solution is encountered when the foils are loaded. The foils begin to contact each other and encounter kinematic constraints of the journal and bearing housing. It is apparent that this provides a highly nonlinear stiffness characteristic of foil journal bearings.

A simplified flow chart of the geometry/elasticity program "Foils" is presented in Figure 3. The following is a discussion of this program and should be useful in understanding how the program deals with foil overlap and boundary conditions. A Fortran listing is provided in Appendix A.

## 2.4 Assembly "Geometry Routine"

As all foil displacements must be referenced from a prescribed datum, the assembly routine provides such a datum; the unloaded assembly position. The predicted assembly position represents the geometry of the foil bearing prior to shaft insertion. This geometry routine has been programmed to search for an acceptable, constant curvature position, Figure 4. When $R_o$ (radius of curvature at the assembly position) satisfies the constraint that $R' = R+t$ where t is the foil thickness, the assembly subroutine reports $R_o$ as well as $R_N$ (the radius to each node from the geometric center of the bearing). It should be noted that $R_o$ may or may not be equal to the free foil radius. (Generally the larger the number of foils, the more likely $R_o$ will be the free foil radius.)

## 2.5 Elasticity "Routine"

As noted in the flow chart (Figure 3), the elasticity solution commences by obtaining the symmetric "preload" position of



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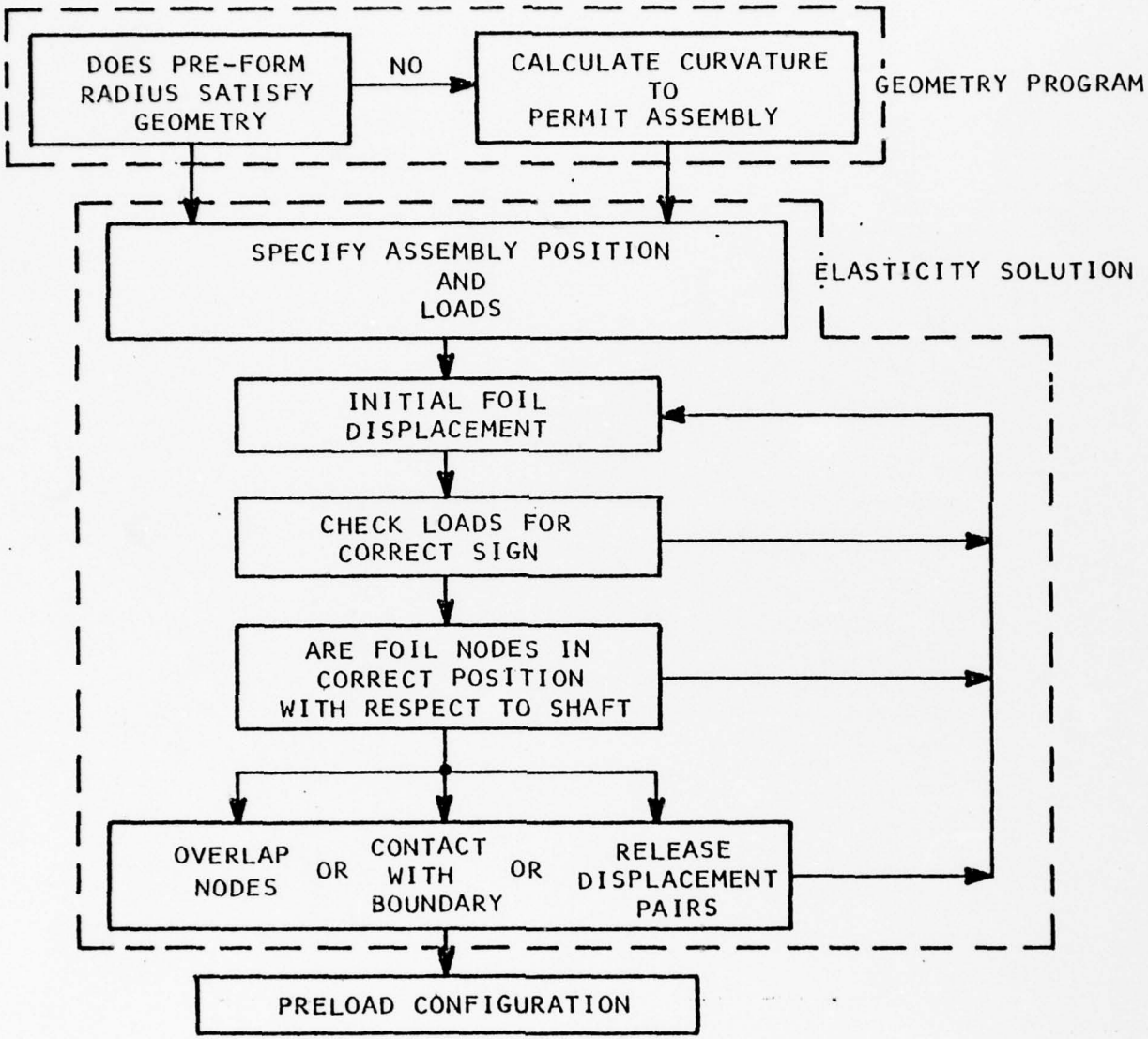



Figure 3. Assembly and Stiffness Flow Chart.



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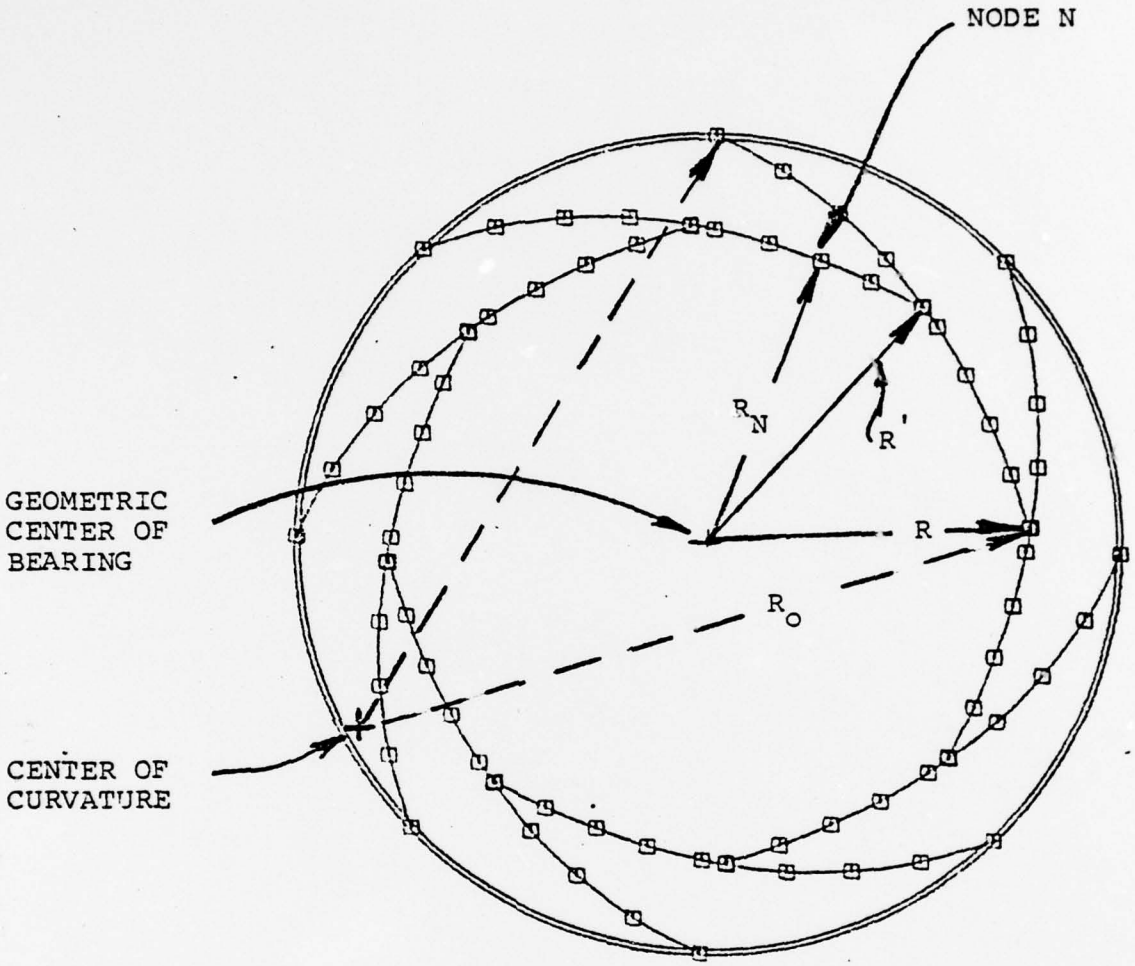



Figure 4. Assembly Position.



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the foils. This is the configuration when the shaft is inserted in a zero-"g" position. The program proceeds from there to obtain the eccentric position of the foils while checking for:

(a) Constraint or release of nodes on adjacent foils and/or contact with boundaries

(b) Constraint or release of nodes on the shaft (S)

(c) Constraint or release of nodes on the bearing housing (B)

Nodal constraint is provided when displacements indicate a violation of kinematic boundaries. Release of nodes occurs when the traction loads produced by constraint are not physically realizable.

## 2.6 Data Presentation

The geometry and coordinate system are shown in Figure 5. The node number system for a typical 8 foil geometry with 10 nodes per foil is illustrated in Figure 6. The numbering system is automatic once the number of nodes per foil and number of foils have been specified.

Figures 7 through 13 exemplify the output or data presentation of Program "Foils". Figure 7 is a summary of the input data as well as the specification of the assembly position, radius of curvature ($R_O$, Figure 4) and the nodal radii ($R_N$, Figure 4). In addition, the shaft radius which will be utilized to determine the symmetric preload position as well as the eccentricity control are presented. "PSI" is the angle ($\Psi$) of Figure 5. Figures 8 through 10 present the results for ecc = 0.0 whereas Figures 11 through 13 present the results for ecc = 0.002 in. The summaries of Figures 10 and 13 note the nodal radial (total) load acting on the shaft due to the preload and eccentricity. In addition, the X and Y



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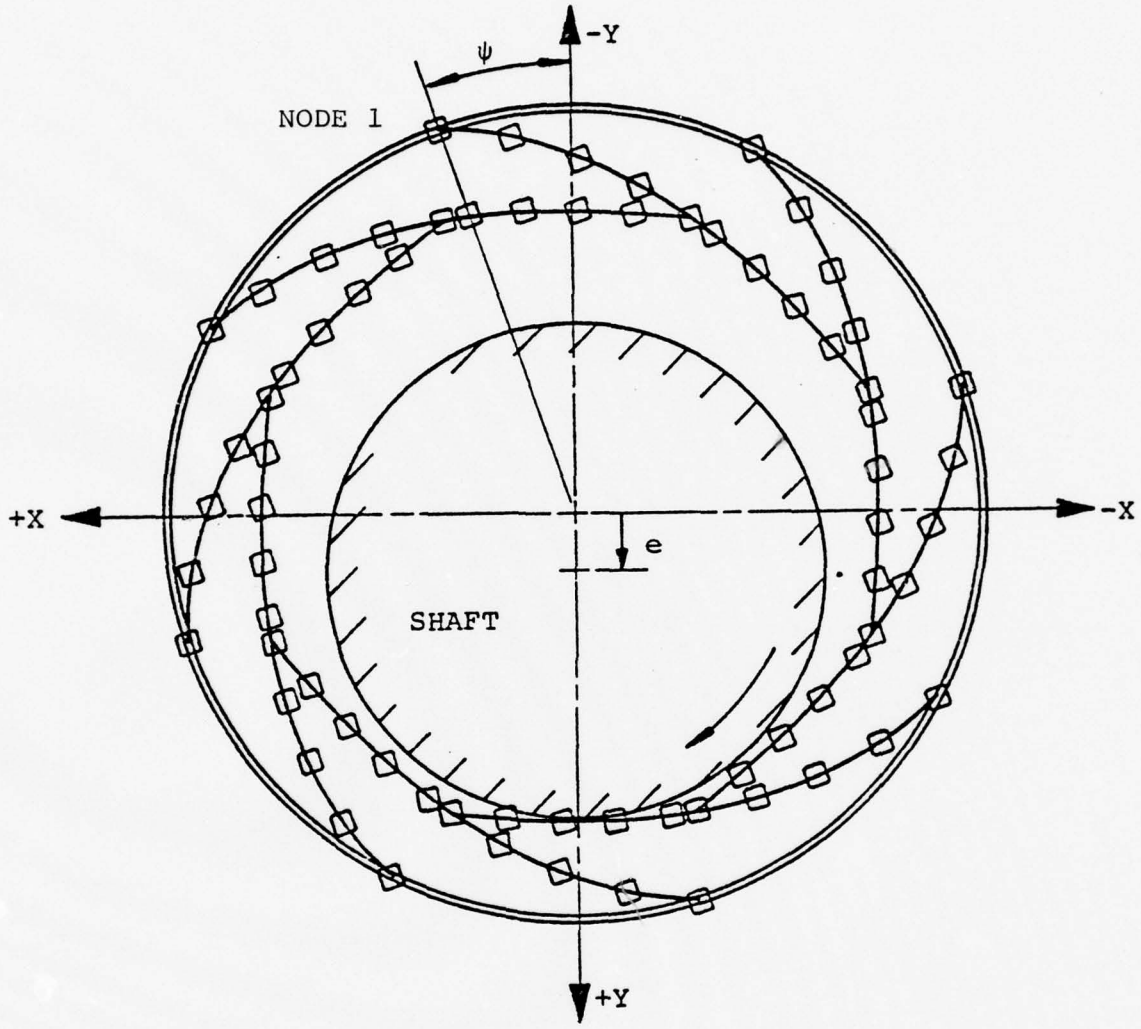



Figure 5. Geometry and Coordinate System for Elasticity Program



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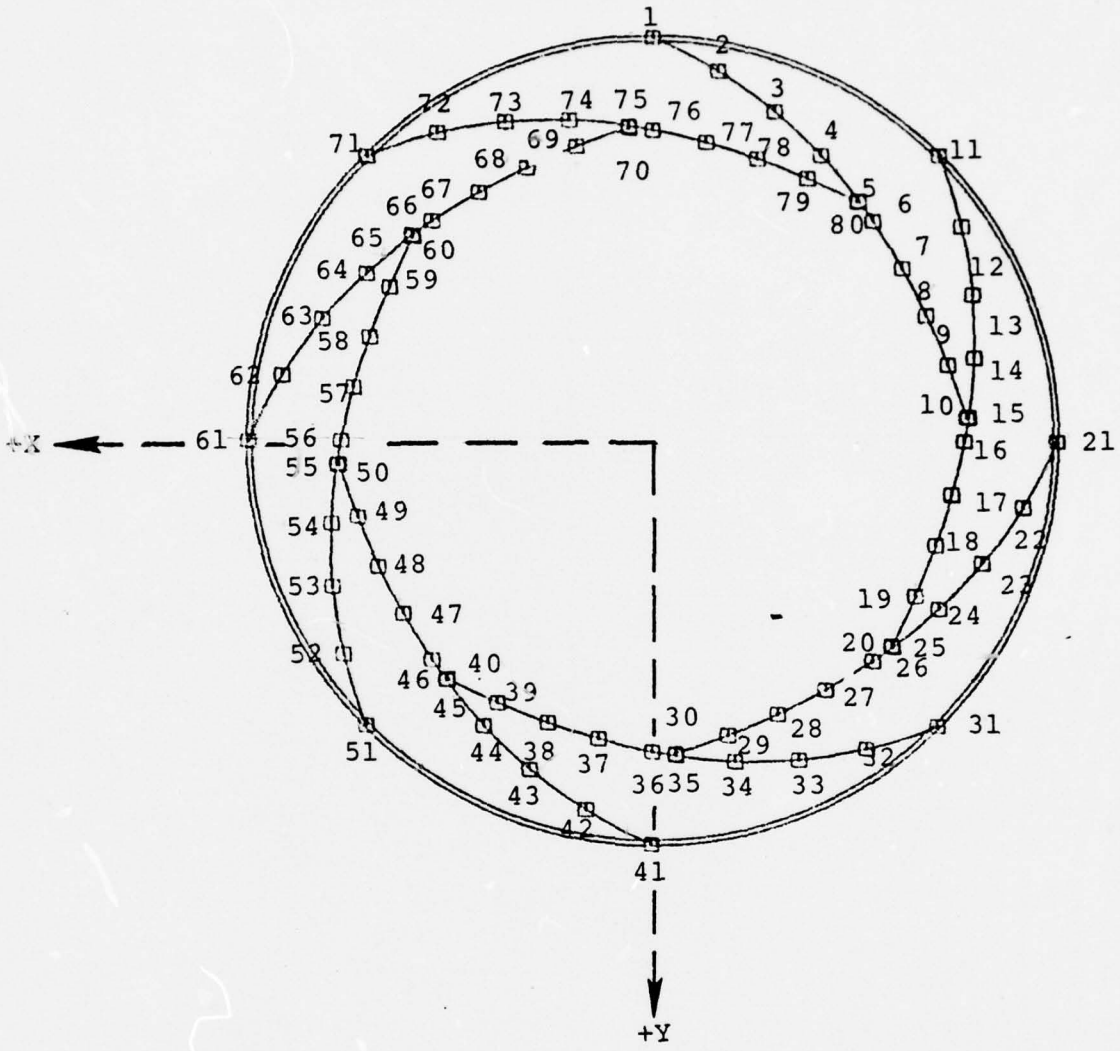



Figure 6. Node Numbering



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12 FOIL TEST

SYSTEM DESCRIPTION

ECCENTRICITY = 0.0000

| FOIL = 1 | RINITIAL | RADIAL DEFL | RFINAL | RADIAL FORCE | OVERLAP PAIRS | B.C. |
|---|---|---|---|---|---|---|
| | | | | | 0 | B |
| NODE = 1 | 2.2740 | 0.0000 | 2.2740 | 10.5163 | D 35 | |
| NODE = 2 | 2.1515 | -.1097 | 2.2612 | -2.1639 | 0 | |
| NODE = 3 | 2.0459 | -.2111 | 2.2570 | .0000 | 0 | |
| NODE = 4 | 1.9598 | -.2970 | 2.2568 | .0000 | 0 | |
| NODE = 5 | 1.8952 | -.3608 | 2.2560 | -13.7862 | D 1 | |
| NODE = 6 | 1.8677 | -.3861 | 2.2539 | -.0000 | 0 | |
| NODE = 7 | 1.8396 | -.4086 | 2.2482 | 2.1641 | D 13 | |
| NODE = 8 | 1.8335 | -.4093 | 2.2428 | .0000 | 0 | |
| NODE = 9 | 1.8442 | -.3918 | 2.2400 | -8.4648 | 0 | S |
| NODE = 10 | 1.8822 | -.3608 | 2.2430 | 13.7840 | D 2 | |

| FOIL = 2 | RINITIAL | RADIAL DEFL | RFINAL | RADIAL FORCE | OVERLAP PAIRS | B.C. |
|---|---|---|---|---|---|---|
| | | | | | 0 | B |
| NODE = 11 | 2.2740 | 0.0000 | 2.2740 | 10.5183 | I 13 | |
| NODE = 12 | 2.1515 | -.1097 | 2.2612 | -2.1641 | 0 | |
| NODE = 13 | 2.0459 | -.2111 | 2.2570 | .0000 | 0 | |
| NODE = 14 | 1.9598 | -.2970 | 2.2568 | .0000 | I 2 | |
| NODE = 15 | 1.8952 | -.3608 | 2.2560 | -13.7848 | 0 | |
| NODE = 16 | 1.8677 | -.3861 | 2.2539 | -.0019 | D 15 | |
| NODE = 17 | 1.8396 | -.4086 | 2.2482 | 2.1696 | 0 | |
| NODE = 18 | 1.8335 | -.4093 | 2.2428 | .0001 | 0 | S |
| NODE = 19 | 1.8442 | -.3918 | 2.2400 | -8.4720 | D 3 | |
| NODE = 20 | 1.8822 | -.3608 | 2.2430 | 13.7879 | | |

| FOIL = 3 | RINITIAL | RADIAL DEFL | RFINAL | RADIAL FORCE | OVERLAP PAIRS | B.C. |
|---|---|---|---|---|---|---|
| | | | | | 0 | B |
| NODE = 21 | 2.2740 | 0.0000 | 2.2740 | 10.5188 | I 15 | |
| NODE = 22 | 2.1515 | -.1097 | 2.2612 | -2.1696 | 0 | |
| NODE = 23 | 2.0459 | -.2111 | 2.2570 | .0000 | 0 | |
| NODE = 24 | 1.9598 | -.2970 | 2.2568 | -.0000 | I 3 | |
| NODE = 25 | 1.8952 | -.3608 | 2.2560 | -13.7877 | 0 | |
| NODE = 26 | 1.8677 | -.3861 | 2.2539 | .0018 | D 17 | |
| NODE = 27 | 1.8396 | -.4086 | 2.2482 | 2.1638 | 0 | |
| NODE = 28 | 1.8335 | -.4093 | 2.2428 | .0001 | 0 | S |
| NODE = 29 | 1.8442 | -.3918 | 2.2400 | -8.4669 | D 4 | |
| NODE = 30 | 1.8822 | -.3608 | 2.2430 | 13.7854 | | |

| FOIL = 4 | RINITIAL | RADIAL DEFL | RFINAL | RADIAL FORCE | OVERLAP PAIRS | B.C. |
|---|---|---|---|---|---|---|
| | | | | | 0 | B |
| NODE = 31 | 2.2740 | 0.0000 | 2.2740 | 10.5182 | I 17 | |
| NODE = 32 | 2.1515 | -.1097 | 2.2612 | -2.1639 | 0 | |
| NODE = 33 | 2.0459 | -.2111 | 2.2570 | .0000 | 0 | |
| NODE = 34 | 1.9598 | -.2970 | 2.2568 | -.0000 | I 4 | |
| NODE = 35 | 1.8952 | -.3608 | 2.2560 | -13.7853 | 0 | |
| NODE = 36 | 1.8677 | -.3861 | 2.2539 | -.0019 | D 19 | |
| NODE = 37 | 1.8396 | -.4086 | 2.2482 | 2.1750 | 0 | |
| NODE = 38 | 1.8335 | -.4093 | 2.2428 | -.0003 | 0 | S |
| NODE = 39 | 1.8442 | -.3918 | 2.2400 | -8.4820 | D 5 | |
| NODE = 40 | 1.8822 | -.3608 | 2.2430 | 13.7941 | | |

| FOIL = 5 | RINITIAL | RADIAL DEFL | RFINAL | RADIAL FORCE | OVERLAP PAIRS | B.C. |
|---|---|---|---|---|---|---|
| | | | | | 0 | B |
| NODE = 41 | 2.2740 | 0.0000 | 2.2740 | 10.5262 | I 19 | |
| NODE = 42 | 2.1515 | -.1097 | 2.2612 | -2.1750 | 0 | |
| NODE = 43 | 2.0459 | -.2111 | 2.2570 | -.0000 | 0 | |
| NODE = 44 | 1.9598 | -.2970 | 2.2568 | .0000 | | |
| | | | | -13.7960 | | |

CONTACT WITH BEARING HOUSING

CONTACT WITH SHAFT

INDEPENDENT AND DEPENDENT CONTACT NODAL PAIR

Figure 8. Results for Eccentricity = 0.0



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| | | | | | | |
|---|---|---|---|---|---|---|
| NODE = 46 | 1.8677 | -.3861 | 2.2538 | .0055 | 0 | |
| NODE = 47 | 1.8346 | -.4086 | 2.2482 | 2.1727 | D 21 | |
| NODE = 48 | 1.8335 | -.4093 | 2.2428 | -.0003 | 0 | |
| NODE = 49 | 1.8442 | -.3918 | 2.2400 | -8.4830 | 0 | S |
| NODE = 50 | 1.8822 | -.3608 | 2.2430 | 13.7953 | D 6 | |

| FOIL = 6 | RINITIAL | RADIAL DEFL | RFINAL | RADIAL FORCE | OVERLAP PAIRS | B.C. |
|---|---|---|---|---|---|---|
| NODE = 51 | 2.2740 | 0.0000 | 2.2740 | 10.5184 | 0 | B |
| NODE = 52 | 2.1515 | -.1097 | 2.2612 | -2.1724 | I 21 | |
| NODE = 53 | 2.0459 | -.2111 | 2.2570 | -.0000 | 0 | |
| NODE = 54 | 1.9598 | -.2970 | 2.2568 | -.0001 | 0 | |
| NODE = 55 | 1.8952 | -.3608 | 2.2560 | -13.7958 | I 6 | |
| NODE = 56 | 1.8677 | -.3861 | 2.2538 | .0055 | 0 | |
| NODE = 57 | 1.8346 | -.4086 | 2.2482 | 2.1719 | D 23 | |
| NODE = 58 | 1.8335 | -.4093 | 2.2428 | -.0003 | 0 | |
| NODE = 59 | 1.8442 | -.3918 | 2.2400 | -8.4842 | 0 | S |
| NODE = 60 | 1.8822 | -.3608 | 2.2430 | 13.7962 | D 7 | |

| FOIL = 7 | RINITIAL | RADIAL DEFL | RFINAL | RADIAL FORCE | OVERLAP PAIRS | B.C. |
|---|---|---|---|---|---|---|
| NODE = 61 | 2.2740 | 0.0000 | 2.2740 | 10.5175 | 0 | B |
| NODE = 62 | 2.1515 | -.1097 | 2.2612 | -2.1719 | I 23 | |
| NODE = 63 | 2.0459 | -.2111 | 2.2570 | -.0000 | 0 | |
| NODE = 64 | 1.9598 | -.2970 | 2.2568 | .0000 | 0 | |
| NODE = 65 | 1.8952 | -.3608 | 2.2560 | -13.7961 | I 7 | |
| NODE = 66 | 1.8677 | -.3861 | 2.2538 | .0055 | 0 | |
| NODE = 67 | 1.8346 | -.4086 | 2.2482 | 2.1749 | D 25 | |
| NODE = 68 | 1.8335 | -.4093 | 2.2428 | -.0003 | 0 | |
| NODE = 69 | 1.8442 | -.3918 | 2.2400 | -8.4898 | 0 | S |
| NODE = 70 | 1.8822 | -.3608 | 2.2430 | 13.7999 | D 8 | |

| FOIL = 8 | RINITIAL | RADIAL DEFL | RFINAL | RADIAL FORCE | OVERLAP PAIRS | B.C. |
|---|---|---|---|---|---|---|
| NODE = 71 | 2.2740 | 0.0000 | 2.2740 | 10.5200 | 0 | B |
| NODE = 72 | 2.1515 | -.1097 | 2.2612 | -2.1751 | I 25 | |
| NODE = 73 | 2.0459 | -.2111 | 2.2570 | -.0000 | 0 | |
| NODE = 74 | 1.9598 | -.2970 | 2.2568 | .0000 | 0 | |
| NODE = 75 | 1.8952 | -.3608 | 2.2560 | -13.8011 | I 8 | |
| NODE = 76 | 1.8677 | -.3861 | 2.2538 | .0055 | 0 | |
| NODE = 77 | 1.8346 | -.4086 | 2.2482 | 2.1950 | D 27 | |
| NODE = 78 | 1.8335 | -.4093 | 2.2428 | .0001 | 0 | |
| NODE = 79 | 1.8442 | -.3918 | 2.2400 | -8.5262 | 0 | S |
| NODE = 80 | 1.8822 | -.3608 | 2.2430 | 13.8212 | D 9 | |

| FOIL = 9 | RINITIAL | RADIAL DEFL | RFINAL | RADIAL FORCE | OVERLAP PAIRS | B.C. |
|---|---|---|---|---|---|---|
| NODE = 81 | 2.2740 | 0.0000 | 2.2740 | 10.5209 | 0 | B |
| NODE = 82 | 2.1515 | -.1097 | 2.2612 | -2.1950 | I 27 | |
| NODE = 83 | 2.0459 | -.2111 | 2.2570 | .0000 | 0 | |
| NODE = 84 | 1.9598 | -.2970 | 2.2568 | -.0001 | 0 | |
| NODE = 85 | 1.8952 | -.3608 | 2.2560 | -13.8211 | I 9 | |
| NODE = 86 | 1.8677 | -.3861 | 2.2538 | .0202 | 0 | |
| NODE = 87 | 1.8346 | -.4086 | 2.2482 | 2.1870 | D 29 | |
| NODE = 88 | 1.8335 | -.4093 | 2.2428 | .0001 | 0 | |
| NODE = 89 | 1.8442 | -.3918 | 2.2400 | -8.5265 | 0 | S |
| NODE = 90 | 1.8822 | -.3608 | 2.2430 | 13.8231 | D 10 | |

| FOIL = 10 | RINITIAL | RADIAL DEFL | RFINAL | RADIAL FORCE | OVERLAP PAIRS | B.C. |
|---|---|---|---|---|---|---|
| NODE = 91 | 2.2740 | 0.0000 | 2.2740 | 10.5158 | 0 | B |
| NODE = 92 | 2.1515 | -.1097 | 2.2612 | -2.1874 | I 29 | |
| NODE = 93 | 2.0459 | -.2111 | 2.2570 | .0000 | 0 | |
| NODE = 94 | 1.9598 | -.2970 | 2.2568 | .0000 | 0 | |
| NODE = 95 | 1.8952 | -.3608 | 2.2560 | -13.8242 | I 10 | |
| NODE = 96 | 1.8677 | -.3861 | 2.2538 | .0202 | 0 | |
| NODE = 97 | 1.8346 | -.4086 | 2.2482 | 2.1852 | D 31 | |
| NODE = 98 | 1.8335 | -.4093 | 2.2428 | .0001 | 0 | |
| NODE = 99 | 1.8442 | -.3918 | 2.2400 | -8.5195 | 0 | S |
| NODE =100 | 1.8822 | -.3608 | 2.2430 | 13.8186 | D 11 | |

Figure 9. Results for Eccentricity = 0.0



82500

| FOIL = 11 | RINITIAL | RADIAL DEFL | RFINAL | RADIAL FORCE | OVERLAP PAIRS | B.C. |
|---|---|---|---|---|---|---|
| NODE =101 | 2.2740 | 0.0000 | 2.2740 | 10.5140 | 0 | B |
| NODE =102 | 2.1515 | -.1097 | 2.2612 | -2.1856 | I 31 | |
| NODE =103 | 2.0459 | -.2111 | 2.2570 | .0000 | 0 | |
| NODE =104 | 1.9538 | -.2970 | 2.2568 | .0000 | 0 | |
| NODE =105 | 1.8852 | -.3608 | 2.2560 | -13.8198 | I 11 | |
| NODE =106 | 1.8677 | -.3861 | 2.2538 | .0202 | 0 | |
| NODE =107 | 1.8396 | -.4086 | 2.2482 | 2.1649 | D 33 | |
| NODE =108 | 1.8335 | -.4093 | 2.2428 | -.0006 | 0 | |
| NODE =109 | 1.8482 | -.3918 | 2.2400 | -8.4834 | 0 | S |
| NODE =110 | 1.8822 | -.3608 | 2.2430 | 13.7973 | D 12 | |

| FOIL = 12 | RINITIAL | RADIAL DEFL | RFINAL | RADIAL FORCE | OVERLAP PAIRS | B.C. |
|---|---|---|---|---|---|---|
| NODE =111 | 2.2740 | 0.0000 | 2.2740 | 10.5123 | 0 | B |
| NODE =112 | 2.1515 | -.1097 | 2.2612 | -2.1649 | I 33 | |
| NODE =113 | 2.0459 | -.2111 | 2.2570 | -.0000 | 0 | |
| NODE =114 | 1.9568 | -.2970 | 2.2568 | .0000 | 0 | |
| NODE =115 | 1.8852 | -.3608 | 2.2560 | -13.7972 | I 12 | |
| NODE =116 | 1.8677 | -.3861 | 2.2538 | .0055 | 0 | |
| NODE =117 | 1.8346 | -.4086 | 2.2482 | 2.1639 | I 35 | |
| NODE =118 | 1.8335 | -.4093 | 2.2428 | .0001 | 0 | |
| NODE =119 | 1.8482 | -.3918 | 2.2400 | -8.4677 | 0 | S |
| NODE =120 | 1.8822 | -.3608 | 2.2430 | 13.7863 | I 1 | |

********** ECCENTRICITY= 0.000000

SHAFT LOADS

| NODE | TOTAL LOAD | FX | FY |
|---|---|---|---|
| 9 | -8.465 | 6.445 | 5.487 |
| 19 | -8.472 | 8.332 | 1.531 |
| 29 | -8.467 | 7.977 | -2.839 |
| 39 | -8.482 | 5.499 | -6.458 |
| 49 | -8.483 | 1.533 | -8.343 |
| 59 | -8.484 | -2.844 | -7.993 |
| 69 | -8.490 | -6.464 | -5.504 |
| 79 | -8.526 | -8.386 | -1.541 |
| 89 | -8.527 | -8.033 | 2.859 |
| 99 | -8.520 | -5.523 | 6.487 |
| 109 | -8.483 | -1.533 | 8.344 |
| 119 | -8.468 | 2.839 | 7.978 |

**********

| RESULTANT FORCE-X | RESULTANT FORCE-Y | TOTAL FORCE | ANGLE |
|---|---|---|---|
| -.1585 | .0073 | .1587 | -1.5251 |

**********



62 88 00

Figure 10. Results for Eccentricity = 0.0

12 FOIL TEST

SYSTEM DESCRIPTION

ECCENTRICITY = .0020

| FOIL = 1 | RINITIAL | RADIAL DEFL | RFINAL | RADIAL FORCE | OVERLAP PAIRS | B.C. |
|---|---|---|---|---|---|---|
| | | | | | 0 | B |
| NODE = 1 | 2.2740 | 0.0000 | 2.2740 | 9.2928 | D 35 | |
| NODE = 2 | 2.1515 | -.1083 | 2.2598 | -.6718 | 0 | |
| NODE = 3 | 2.0459 | -.2089 | 2.2548 | .0000 | 0 | |
| NODE = 4 | 1.9598 | -.2947 | 2.2544 | .0000 | D 1 | |
| NODE = 5 | 1.8952 | -.3589 | 2.2541 | -13.3327 | 0 | |
| NODE = 6 | 1.8677 | -.3845 | 2.2522 | -.0000 | D 13 | |
| NODE = 7 | 1.8396 | -.4074 | 2.2471 | .8604 | 0 | |
| NODE = 8 | 1.8335 | -.4082 | 2.2417 | .0000 | 0 | S |
| NODE = 9 | 1.8482 | -.3905 | 2.2387 | -7.6709 | D 2 | |
| NODE = 10 | 1.8822 | -.3594 | 2.2416 | 13.5460 | | |

| FOIL = 2 | RINITIAL | RADIAL DEFL | RFINAL | RADIAL FORCE | OVERLAP PAIRS | B.C. |
|---|---|---|---|---|---|---|
| | | | | | 0 | B |
| NODE = 11 | 2.2740 | 0.0000 | 2.2740 | 9.4585 | I 13 | |
| NODE = 12 | 2.1515 | -.1086 | 2.2601 | -.8604 | 0 | |
| NODE = 13 | 2.0459 | -.2094 | 2.2553 | .0000 | 0 | |
| NODE = 14 | 1.9598 | -.2952 | 2.2550 | .0000 | I 2 | |
| NODE = 15 | 1.8952 | -.3594 | 2.2546 | -13.5460 | 0 | |
| NODE = 16 | 1.8677 | -.3851 | 2.2528 | -.0019 | D 15 | |
| NODE = 17 | 1.8396 | -.4080 | 2.2477 | 1.4035 | 0 | |
| NODE = 18 | 1.8335 | -.4089 | 2.2425 | .0001 | 0 | S |
| NODE = 19 | 1.8482 | -.3914 | 2.2396 | -8.2502 | D 3 | |
| NODE = 20 | 1.8822 | -.3604 | 2.2426 | 13.8291 | | |

| FOIL = 3 | RINITIAL | RADIAL DEFL | RFINAL | RADIAL FORCE | OVERLAP PAIRS | B.C. |
|---|---|---|---|---|---|---|
| | | | | | 0 | B |
| NODE = 21 | 2.2740 | 0.0000 | 2.2740 | 9.9066 | I 15 | |
| NODE = 22 | 2.1515 | -.1092 | 2.2607 | -1.4036 | 0 | |
| NODE = 23 | 2.0459 | -.2103 | 2.2563 | .0000 | 0 | |
| NODE = 24 | 1.9598 | -.2963 | 2.2561 | -.0000 | I 3 | |
| NODE = 25 | 1.8952 | -.3604 | 2.2556 | -13.8290 | 0 | |
| NODE = 26 | 1.8677 | -.3860 | 2.2537 | .0018 | D 17 | |
| NODE = 27 | 1.8396 | -.4088 | 2.2484 | 2.1407 | 0 | |
| NODE = 28 | 1.8335 | -.4098 | 2.2433 | .0001 | 0 | S |
| NODE = 29 | 1.8482 | -.3925 | 2.2407 | -8.8767 | D 4 | |
| NODE = 30 | 1.8822 | -.3615 | 2.2437 | 14.0950 | | |

| FOIL = 4 | RINITIAL | RADIAL DEFL | RFINAL | RADIAL FORCE | OVERLAP PAIRS | B.C. |
|---|---|---|---|---|---|---|
| | | | | | 0 | B |
| NODE = 31 | 2.2740 | 0.0000 | 2.2740 | 10.5177 | I 17 | |
| NODE = 32 | 2.1515 | -.1099 | 2.2614 | -2.1407 | 0 | |
| NODE = 33 | 2.0459 | -.2115 | 2.2574 | .0000 | 0 | |
| NODE = 34 | 1.9598 | -.2975 | 2.2573 | -.0000 | I 4 | |
| NODE = 35 | 1.8952 | -.3615 | 2.2567 | -14.0948 | 0 | |
| NODE = 36 | 1.8677 | -.3869 | 2.2546 | -.0019 | D 19 | |
| NODE = 37 | 1.8396 | -.4095 | 2.2491 | 2.9010 | 0 | |
| NODE = 38 | 1.8335 | -.4105 | 2.2441 | -.0003 | 0 | S |
| NODE = 39 | 1.8482 | -.3933 | 2.2415 | -9.4139 | D 5 | |
| NODE = 40 | 1.8822 | -.3624 | 2.2446 | 14.2891 | | |

| FOIL = 5 | RINITIAL | RADIAL DEFL | RFINAL | RADIAL FORCE | OVERLAP PAIRS | B.C. |
|---|---|---|---|---|---|---|
| | | | | | 0 | B |
| NODE = 41 | 2.2740 | 0.0000 | 2.2740 | 11.1316 | I 19 | |
| NODE = 42 | 2.1515 | -.1106 | 2.2621 | -2.9010 | 0 | |
| NODE = 43 | 2.0459 | -.2125 | 2.2585 | -.0000 | 0 | |
| NODE = 44 | 1.9598 | -.2986 | 2.2584 | .0000 | I 5 | |
| NODE = 45 | 1.8952 | -.3624 | 2.2576 | -14.2890 | | |

Figure 11. Results for Eccentricity = 0.002



82 50 0

| | | | | | | |
|---|---|---|---|---|---|---|
| NODE = 46 | 1.8677 | -.3876 | 2.2553 | .0056 | 0 | |
| NODE = 47 | 1.8396 | -.4099 | 2.2496 | 3.4535 | D 21 | |
| NODE = 48 | 1.8335 | -.4109 | 2.2445 | -.0003 | 0 | |
| NODE = 49 | 1.8442 | -.3938 | 2.2420 | -9.6870 | 0 | S |
| NODE = 50 | 1.8822 | -.3629 | 2.2451 | 14.3430 | D 6 | |

| FOIL = 6 | RINITIAL | RADIAL DEFL | RFINAL | RADIAL FORCE | OVERLAP PAIRS | B.C. |
|---|---|---|---|---|---|---|
| NODE = 51 | 2.2740 | 0.0000 | 2.2740 | 11.5779 | 0 | B |
| NODE = 52 | 2.1515 | -.1111 | 2.2626 | -3.4537 | I 21 | |
| NODE = 53 | 2.0459 | -.2132 | 2.2592 | -.0000 | 0 | |
| NODE = 54 | 1.9598 | -.2993 | 2.2591 | -.0001 | 0 | |
| NODE = 55 | 1.8952 | -.3629 | 2.2581 | -14.3435 | I 6 | |
| NODE = 56 | 1.8677 | -.3879 | 2.2556 | .0056 | 0 | |
| NODE = 57 | 1.8396 | -.4100 | 2.2497 | 3.6640 | D 23 | |
| NODE = 58 | 1.8335 | -.4109 | 2.2444 | -.0003 | 0 | |
| NODE = 59 | 1.8442 | -.3937 | 2.2419 | -9.6375 | 0 | S |
| NODE = 60 | 1.8822 | -.3628 | 2.2450 | 14.2497 | D 7 | |

| FOIL = 7 | RINITIAL | RADIAL DEFL | RFINAL | RADIAL FORCE | OVERLAP PAIRS | B.C. |
|---|---|---|---|---|---|---|
| NODE = 61 | 2.2740 | 0.0000 | 2.2740 | 11.7411 | 0 | B |
| NODE = 62 | 2.1515 | -.1112 | 2.2627 | -3.6639 | I 23 | |
| NODE = 63 | 2.0459 | -.2133 | 2.2593 | -.0000 | 0 | |
| NODE = 64 | 1.9598 | -.2993 | 2.2591 | .0000 | 0 | |
| NODE = 65 | 1.8952 | -.3628 | 2.2580 | -14.2496 | I 7 | |
| NODE = 66 | 1.8677 | -.3878 | 2.2555 | .0056 | 0 | |
| NODE = 67 | 1.8396 | -.4098 | 2.2494 | 3.4782 | D 25 | |
| NODE = 68 | 1.8335 | -.4104 | 2.2440 | -.0003 | 0 | |
| NODE = 69 | 1.8442 | -.3931 | 2.2413 | -9.2831 | 0 | S |
| NODE = 70 | 1.8822 | -.3622 | 2.2444 | 14.0376 | D 8 | |

| FOIL = 8 | RINITIAL | RADIAL DEFL | RFINAL | RADIAL FORCE | OVERLAP PAIRS | B.C. |
|---|---|---|---|---|---|---|
| NODE = 71 | 2.2740 | 0.0000 | 2.2740 | 11.5794 | 0 | B |
| NODE = 72 | 2.1515 | -.1109 | 2.2624 | -3.4784 | I 25 | |
| NODE = 73 | 2.0459 | -.2128 | 2.2588 | -.0000 | 0 | |
| NODE = 74 | 1.9598 | -.2987 | 2.2585 | .0000 | 0 | |
| NODE = 75 | 1.8952 | -.3622 | 2.2574 | -14.0388 | I 8 | |
| NODE = 76 | 1.8677 | -.3872 | 2.2549 | .0056 | 0 | |
| NODE = 77 | 1.8396 | -.4092 | 2.2488 | 2.9601 | D 27 | |
| NODE = 78 | 1.8335 | -.4097 | 2.2432 | .0001 | 0 | |
| NODE = 79 | 1.8442 | -.3922 | 2.2404 | -8.7469 | 0 | S |
| NODE = 80 | 1.8822 | -.3612 | 2.2434 | 13.7795 | D 9 | |

| FOIL = 9 | RINITIAL | RADIAL DEFL | RFINAL | RADIAL FORCE | OVERLAP PAIRS | B.C. |
|---|---|---|---|---|---|---|
| NODE = 81 | 2.2740 | 0.0000 | 2.2740 | 11.1323 | 0 | B |
| NODE = 82 | 2.1515 | -.1103 | 2.2618 | -2.9601 | I 27 | |
| NODE = 83 | 2.0459 | -.2119 | 2.2578 | .0000 | 0 | |
| NODE = 84 | 1.9598 | -.2977 | 2.2575 | -.0001 | 0 | |
| NODE = 85 | 1.8952 | -.3612 | 2.2564 | -13.7794 | I 9 | |
| NODE = 86 | 1.8677 | -.3863 | 2.2540 | .0203 | 0 | |
| NODE = 87 | 1.8396 | -.4084 | 2.2480 | 2.2088 | D 29 | |
| NODE = 88 | 1.8335 | -.4088 | 2.2423 | .0001 | 0 | |
| NODE = 89 | 1.8442 | -.3911 | 2.2393 | -8.1155 | 0 | S |
| NODE = 90 | 1.8822 | -.3601 | 2.2423 | 13.5131 | D 10 | |

| FOIL = 10 | RINITIAL | RADIAL DEFL | RFINAL | RADIAL FORCE | OVERLAP PAIRS | B.C. |
|---|---|---|---|---|---|---|
| NODE = 91 | 2.2740 | 0.0000 | 2.2740 | 10.5152 | 0 | B |
| NODE = 92 | 2.1515 | -.1095 | 2.2610 | -2.2092 | I 29 | |
| NODE = 93 | 2.0459 | -.2107 | 2.2567 | .0000 | 0 | |
| NODE = 94 | 1.9598 | -.2964 | 2.2562 | .0000 | 0 | |
| NODE = 95 | 1.8952 | -.3601 | 2.2553 | -13.5142 | I 10 | |
| NODE = 96 | 1.8677 | -.3854 | 2.2531 | .0202 | 0 | |
| NODE = 97 | 1.8396 | -.4077 | 2.2473 | 1.4580 | D 31 | |
| NODE = 98 | 1.8335 | -.4081 | 2.2416 | .0001 | 0 | |
| NODE = 99 | 1.8442 | -.3903 | 2.2385 | -7.5870 | 0 | S |
| NODE =100 | 1.8822 | -.3592 | 2.2414 | 13.3235 | D 11 | |



0 0 2 5 0 3

Figure 12. Results for Eccentricity = 0.002

| FOIL = 11 | RINITIAL | RADIAL DEFL | RFINAL | RADIAL FORCE | OVERLAP PAIRS | B.C. |
|---|---|---|---|---|---|---|
| NODE =101 | 2.2740 | 0.0000 | 2.2740 | 9.9018 | 0 | B |
| NODE =102 | 2.1515 | -.1088 | 2.2603 | -1.4585 | I 31 | |
| NODE =103 | 2.0459 | -.2096 | 2.2556 | .0000 | 0 | |
| NODE =104 | 1.9548 | -.2953 | 2.2501 | .0000 | 0 | |
| NODE =105 | 1.8852 | -.3592 | 2.2544 | -13.3246 | I 11 | |
| NODE =106 | 1.8677 | -.3847 | 2.2524 | .0201 | 0 | |
| NODE =107 | 1.8396 | -.4072 | 2.2469 | .8838 | D 33 | |
| NODE =108 | 1.8335 | -.4077 | 2.2412 | -.0006 | 0 | |
| NODE =109 | 1.8442 | -.3898 | 2.2380 | -7.2794 | 0 | S |
| NODE =110 | 1.8822 | -.3588 | 2.2410 | 13.2497 | D 12 | |

| FOIL = 12 | RINITIAL | RADIAL DEFL | RFINAL | RADIAL FORCE | OVERLAP PAIRS | B.C. |
|---|---|---|---|---|---|---|
| NODE =111 | 2.2740 | 0.0000 | 2.2740 | 9.4526 | 0 | B |
| NODE =112 | 2.1515 | -.1084 | 2.2599 | -.8838 | I 33 | |
| NODE =113 | 2.0459 | -.2090 | 2.2549 | -.0000 | 0 | |
| NODE =114 | 1.9548 | -.2947 | 2.2545 | .0000 | 0 | |
| NODE =115 | 1.8852 | -.3588 | 2.2540 | -13.2496 | I 12 | |
| NODE =116 | 1.8677 | -.3844 | 2.2521 | .0055 | 0 | |
| NODE =117 | 1.8396 | -.4071 | 2.2468 | .6718 | I 35 | |
| NODE =118 | 1.8335 | -.4077 | 2.2412 | .0001 | 0 | |
| NODE =119 | 1.8442 | -.3899 | 2.2381 | -7.3144 | 0 | S |
| NODE =120 | 1.8822 | -.3589 | 2.2411 | 13.3328 | I 1 | |

********** ECCENTRICITY= .002000

SHAFT LOADS

| NODE | TOTAL LOAD | FX | FY |
|---|---|---|---|
| 9 | -7.671 | 5.841 | 4.973 |
| 19 | -8.260 | 8.114 | 1.491 |
| 29 | -8.877 | 8.363 | -2.976 |
| 39 | -9.414 | 6.103 | -7.168 |
| 49 | -9.687 | 1.751 | -9.528 |
| 59 | -9.638 | -3.231 | -9.080 |
| 69 | -9.283 | -7.068 | -6.018 |
| 79 | -8.747 | -8.603 | -1.581 |
| 89 | -8.116 | -7.646 | 2.721 |
| 99 | -7.587 | -4.918 | 5.777 |
| 109 | -7.279 | -1.316 | 7.160 |
| 119 | -7.314 | 2.452 | 6.891 |

**********

| RESULTANT FORCE-X | RESULTANT FORCE-Y | TOTAL FORCE | ANGLE |
|---|---|---|---|
| -.1583 | -7.3377 | 7.3394 | -3.1200 |

**********



82500

Figure 13. Results for Eccentricity = 0.002

components are presented. The resultant forces acting on the shaft are also specified, i.e., $\Sigma F_x$, $\Sigma F_y$, total resulting force and attitude "angle".

2.7 Input Data Presentation (Figures 14 and 15)

Card I - Title Card Format (10A8)

Provided for a descriptive title of the problem being analyzed.

Card II - Foil Geometry Card Format (8F10.5)

Word 1 - Number of foils

Word 2 - Number of nodes per foil (6, 8 or 10)

Word 3 - Radius of bearing (inches)

Word 4 - Axial length of bearing (inches)

Word 5 - Thickness of elastic foil base metal (inches)

Word 6 - Thickness of nonstructural coating (inches)

Word 7 - Arc length of foil (inches)

Word 8 - Free foil radius (inches)

Card III - Plotting Card for Future Program Development

"Leave Blank"

Card IV - Foil Modulus of Elasticity Card Format (F10.0)

Word 1 - Modulus of elasticity (psi x $10^{-6}$)



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Card V - Shaft Radius Card Format (F10.0)

Word 1 - Shaft radius (inches)

Card VI - Eccentricity Control Card Format (3F10.0)

Word 1 - Final eccentricity (inches)
Word 2 - Increment of eccentricity (inches)
Word 3 - Initial eccentricity (inches)

Card VII - Attitude Control Card Format (F10.0)

Word 1 - Angle ($\Psi$) of Figure 5 (Radians)

## 2.8 Comparison of Analytical and Experimental Data

Numerous test cases have been evaluated to demonstrate the programs capability in recognizing proper release, kinematic constraints, and foil overlap in duplicating experimental static stiffness data. A thorough examination of the elasticity program and correlation with experimental data has demonstrated the adequacy of this portion of the elasto-hydrodynamics journal bearing program. Some of these results are presented below:

- Figure 16 illustrates a typical foil geometry and the coordinate system utilized in this study. Note that the positive direction of eccentricity (e) has been established in the direction of the positive Y axis. Accordingly, a negative value of ($F_y$) on the journal opposes a positive value of eccentricity. Further, a positive value of ($F_x$) encourages forward precession (whirl), whereas a negative value of ($F_x$) opposes forward whirl. The angle ($\Psi$) is a geometric parameter and is a user input option to control the displacement vector (eccentricity) direction with respect to foil geometry.



62500

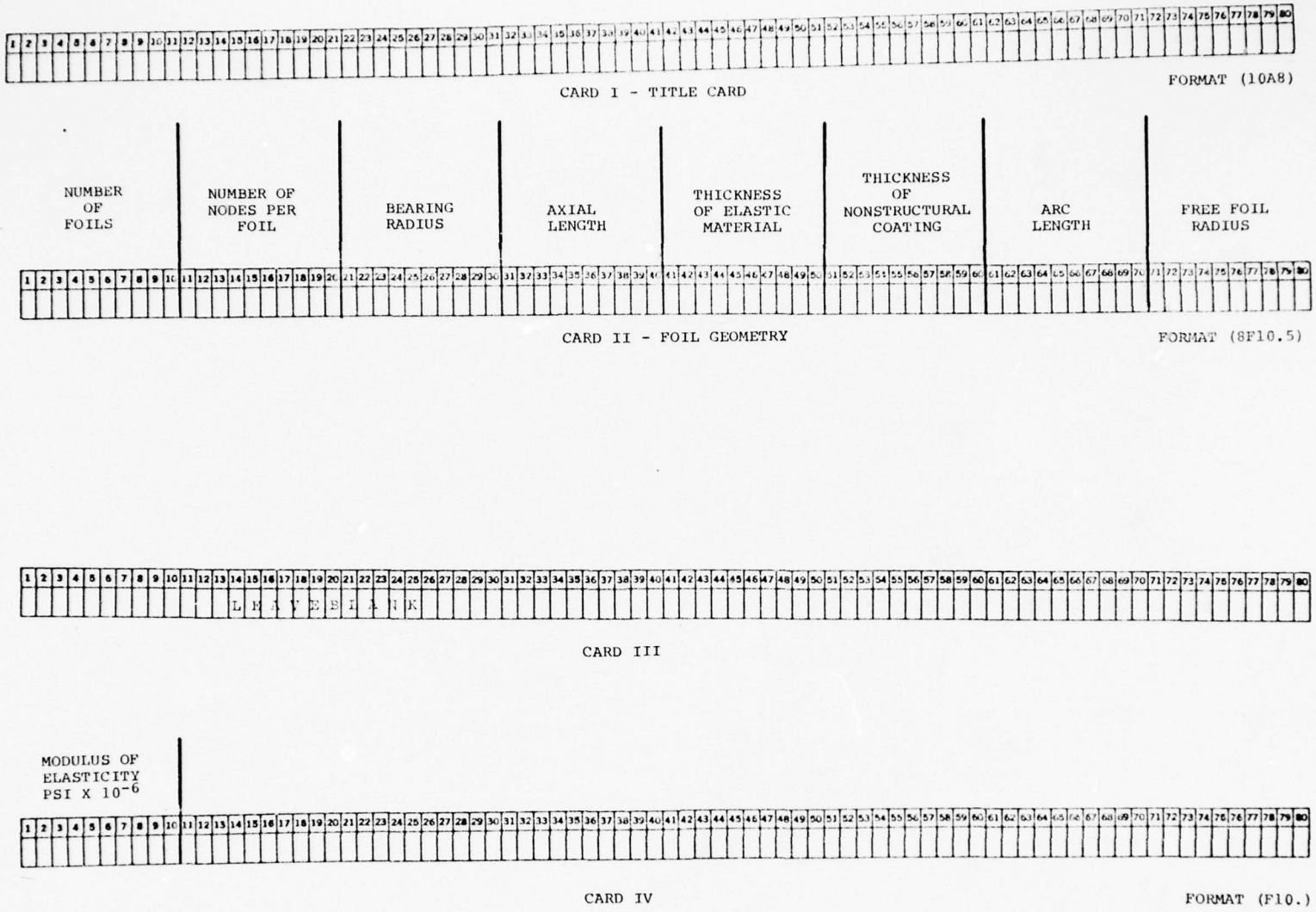
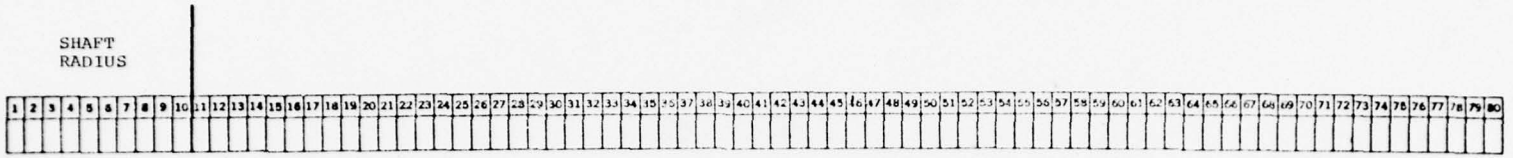



Figure 14. Input Data Presentation (Cards I through IV)

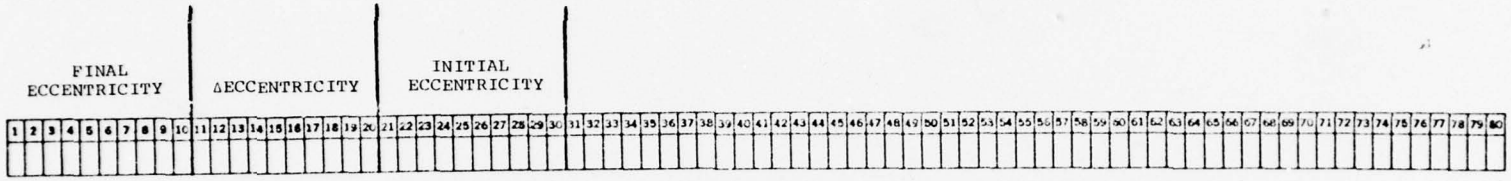


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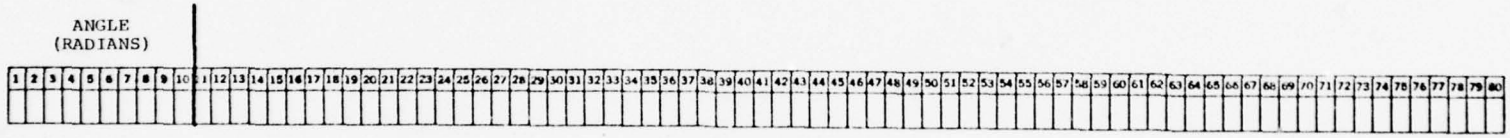

CARD V - SHAFT RADIUS

FORMAT (F10.)




CARD VI - ECCENTRICITY

FORMAT (3F10.)




CARD VII - ATTITUDE ANGLE

FORMAT (F10.)

Figure 15. Input Data Presentation (Cards V through VII)



00239

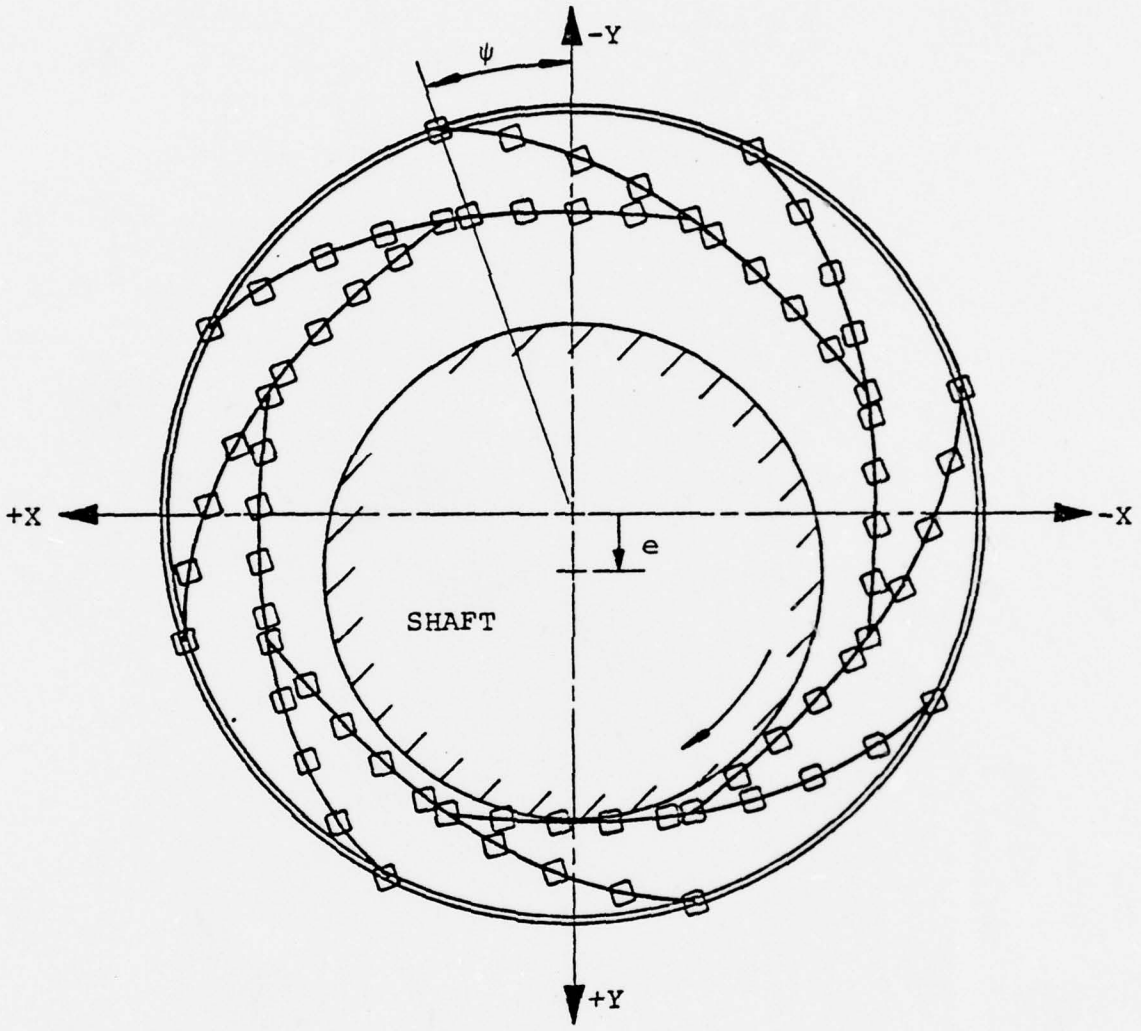



Figure 16. Geometry and Coordinate System



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- Figure 17 shows a comparison of experimental data and analytical data for a 0.0085 inch thick 16-segment foil coated with 0.002 inch of Teflon-S. As shown, excellent correlation was achieved.

- Figure 18 is a comparison of analytic and experimental data for a 0.010 thick uncoated 8-segment foil. Two curves are present; one for the displacement vector (eccentricity) directed toward the trailing edge (T.E.) of a foil, the other with the eccentricity directed midway between two trailing edges of adjacent foils. It is interesting that both experimental and analytic data demonstrate the "stiffer" curve is produced when loading is directed midway between the trailing edges of two adjacent foils.

- Figure 19 presents the data obtained for a 0.012 inch thick 12-segment foil coated with 0.001 inch of Teflon-S. Two curves for the experimental and analytic study are presented similar to those of Figure 18 for the 8-segment foil. It is noteworthy that unlike Figure 18, the experimental curves for loading over the trailing edge and loading between adjacent foils cross at approximately 0.005 inch eccentricity. This same characteristic is duplicated at an eccentricity of 0.006 inch for the analytic data.

- Figure 20 presents the loading obtained analytically, which represents the resultant orthogonal load $F_x$ (see Figure 5), for the 12-segment foil studied in Figure 19. The magnitude of this load is small in comparison to the load-resisting eccentricity ($F_y$) of Figure 19. It is interesting to note the apparent symmetry when the loading direction is altered.



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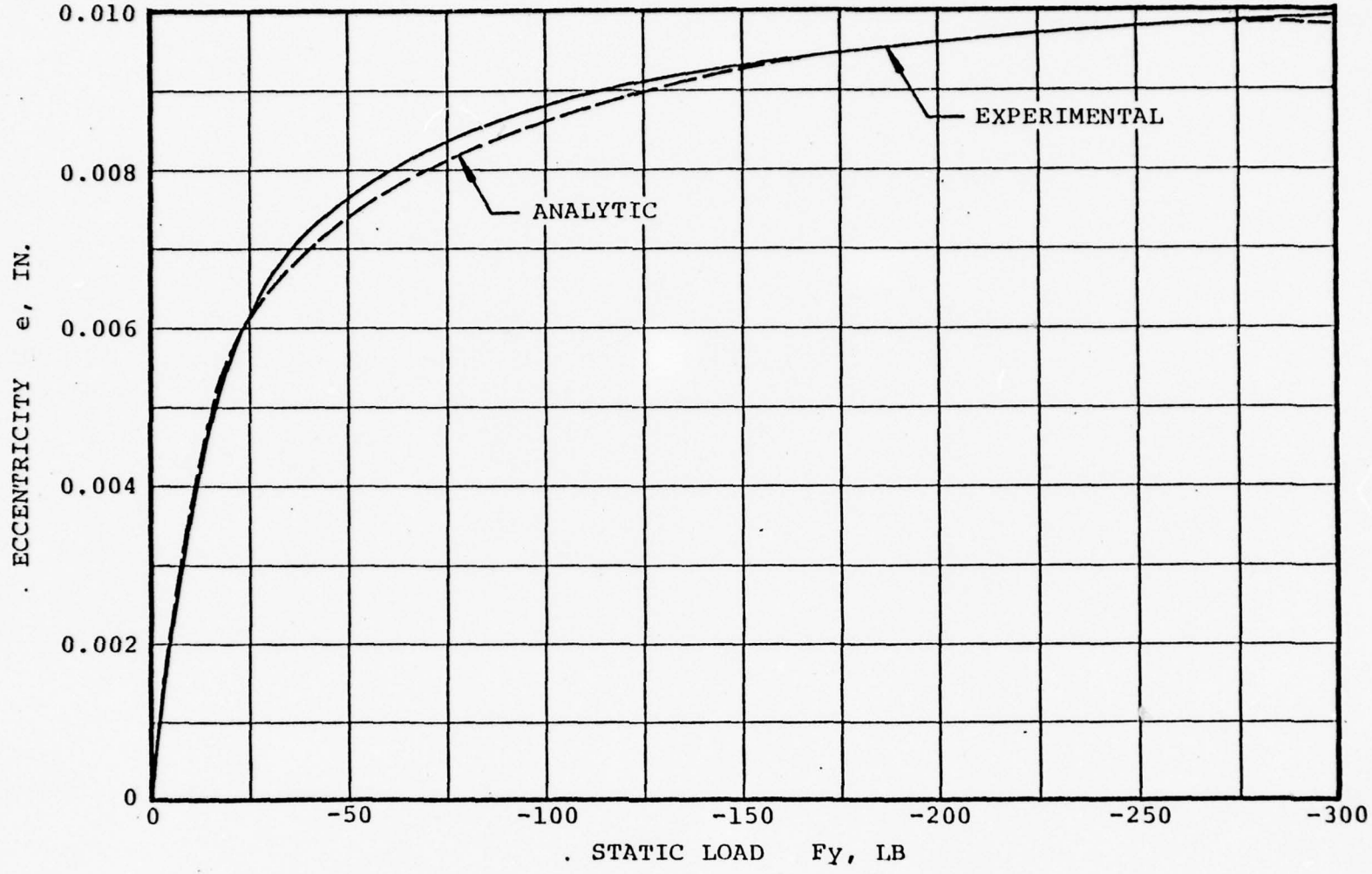



Figure 17. Sixteen-Foil Geometry Load Versus Eccentricity



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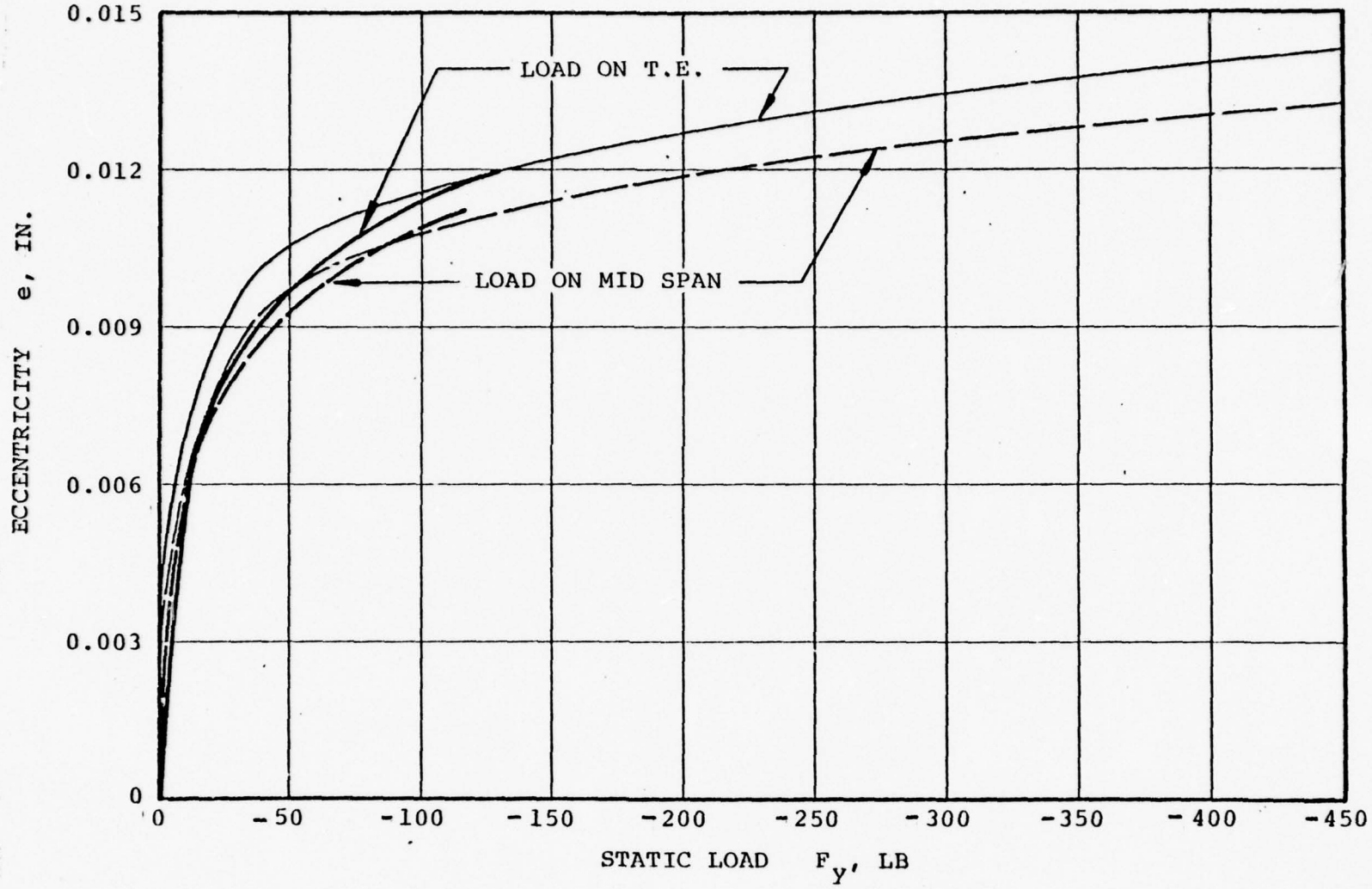



Figure 18. Eight-Segment Journal Bearing (0.010)



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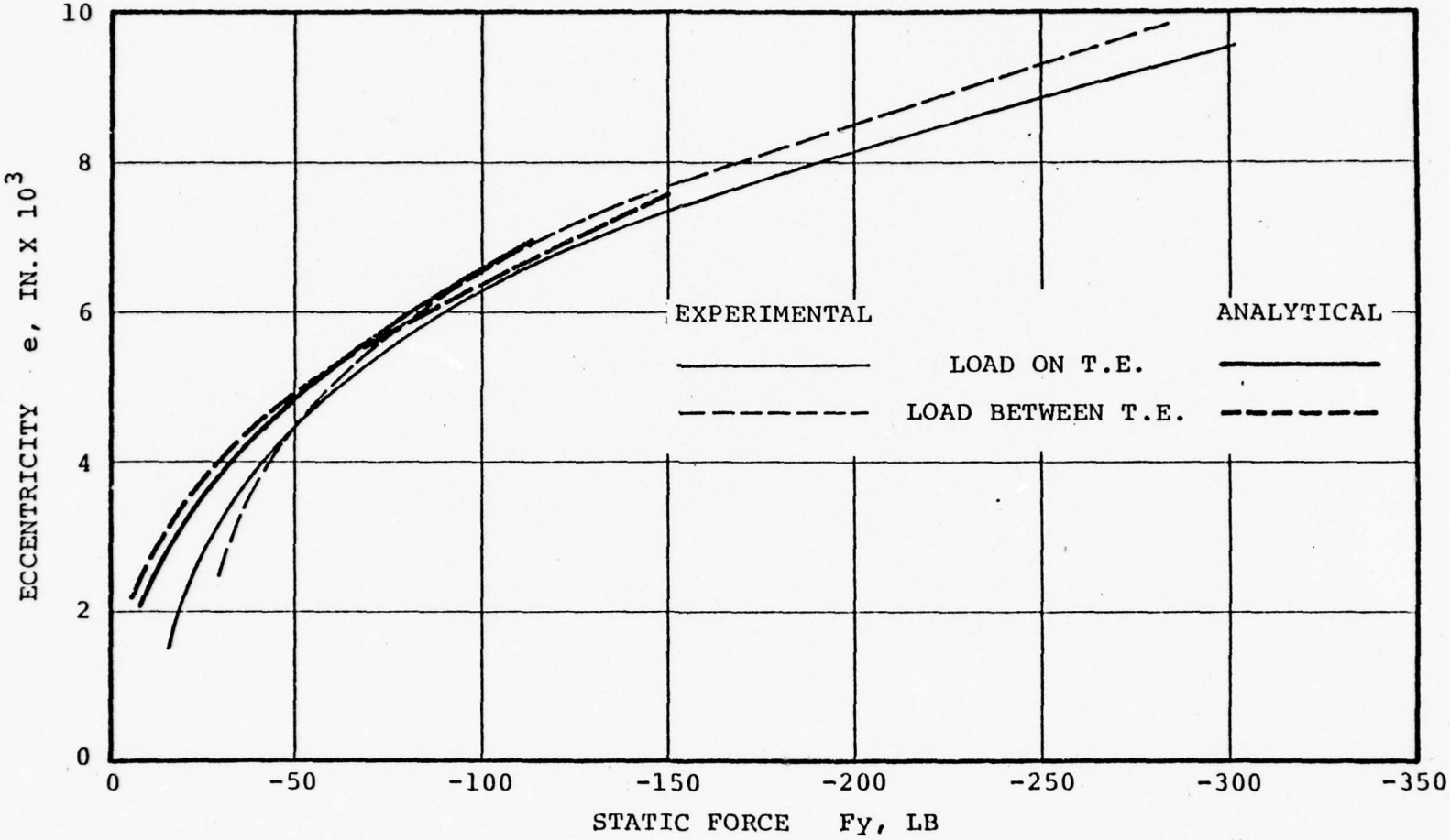



Figure 19. Twelve-Segment Foil Effect of Load Direction



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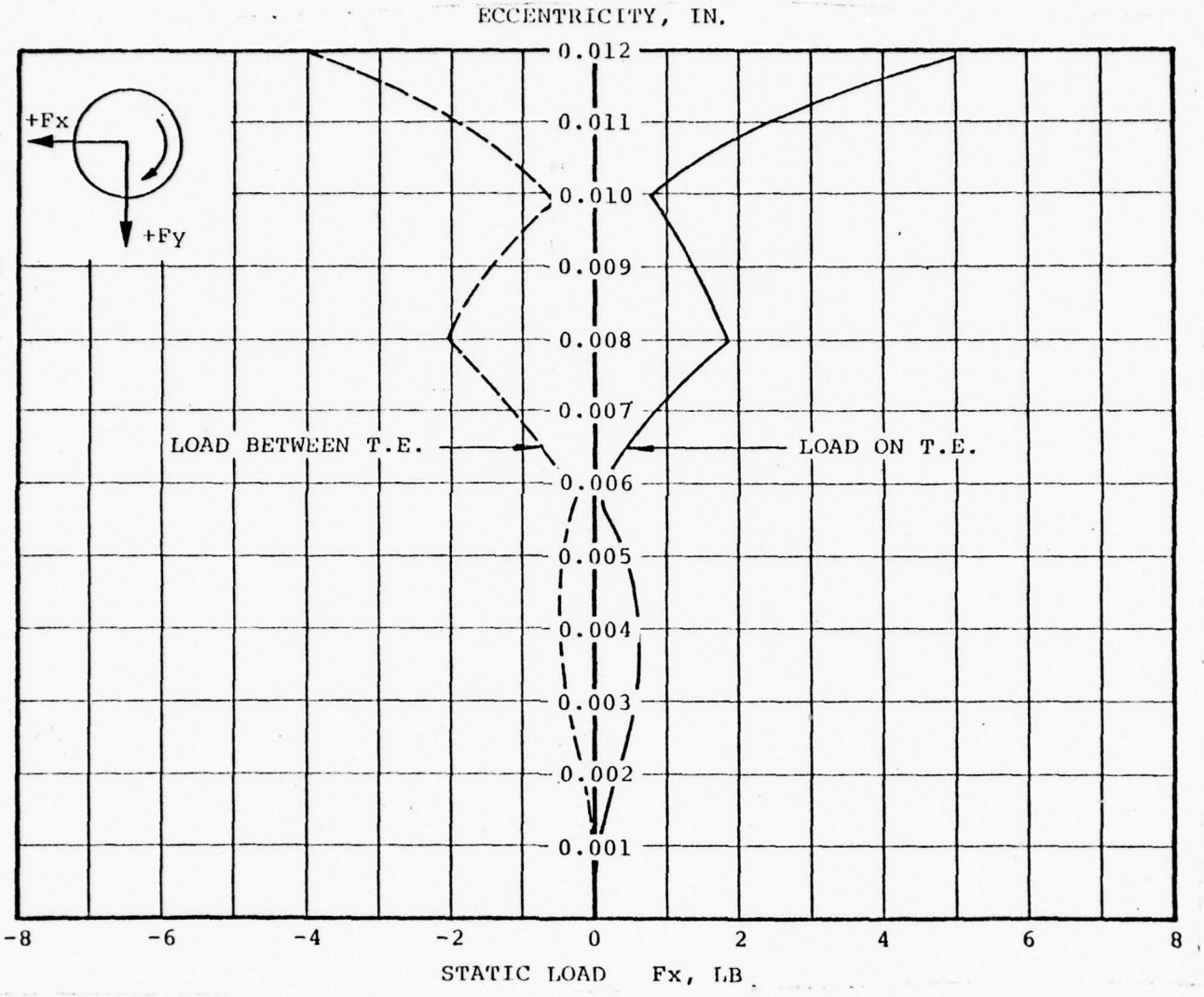



Figure 20. Twelve-Segment Foil Orthogonal Loading



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- Figure 21 is a 12-segment design analytic study of the effect of foil length on static stiffness. The solid line represents a minimum foil length (0.010 inch less than nominal) or a foil overlap of 47.2 percent. The "stiffer" dashed curve illustrates the load versus deflection data for a maximum foil length (0.010 inch greater than nominal) or an overlap of 47.7 percent (the nominal foil overlap is 47.5 percent).



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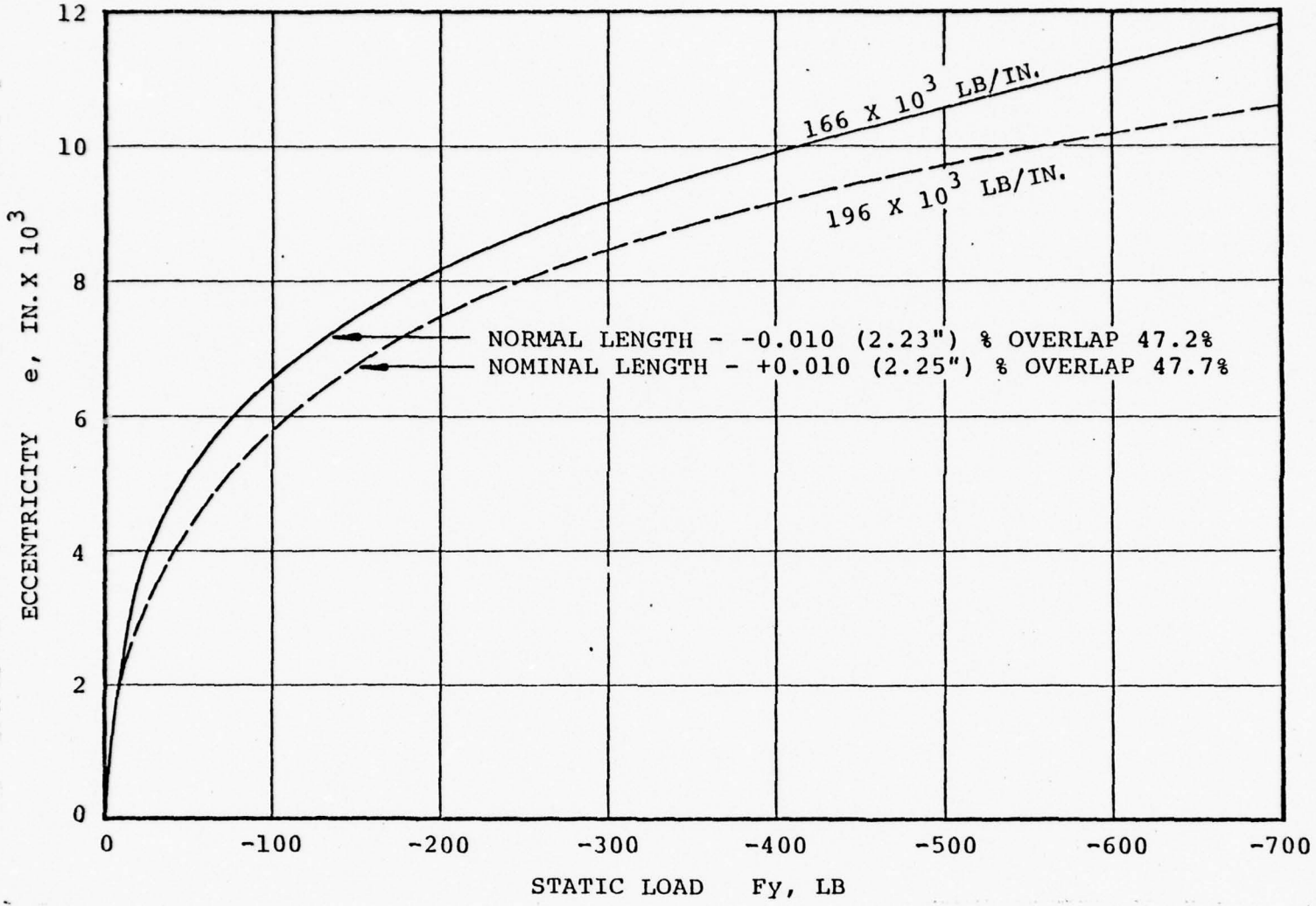



Figure 21. Twelve-Segment Foil Effect of Length



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## SECTION III

## JOURNAL BEARING ANALYTIC PROGRAM

### 3.1 General

The foil journal bearing computer elasto-hydrodynamic analysis parallels the thrust bearing computer analysis program. A separate hydrodynamics subroutine and elasticity subroutine exchange the appropriate information on loads and foil deformations until convergence is achieved. Convergence is attained when the hydrodynamic film thickness used to obtain the pressure distribution and resulting foil loading is the same film thickness (within a reasonable error) predicted by the elasticity program when the hydrodynamic loads are imposed on the foils. The Foil Journal Bearing Program flow chart is provided in Figure 22. One fundamental but significant feature of journal bearing geometry, is that journal foil segments are not independent elastic members but are in contact with each other. Thus, each foil encounters loading due to the hydrodynamics of the bearing as well as traction loads and kinematic constraints from foil interaction. In simple terms, foils may: (1) be in contact with each other, (2) be in contact with each other and constrained by the bearing housing, (3) be in contact with boundaries and not in contact with other foils, or (4) be in contact neither with other foils nor boundaries. These conditions must be correctly assessed by the elasticity program, thereby requiring a difficult nonlinear iterative elasticity subroutine to be programmed. This has been successfully achieved.

### 3.2 Discussion of Geometry Subroutine

As all foil displacements must be referenced from prescribed datum, it is first necessary to determine this reference configuration. For the foil thrust bearing this datum is the free foil geometry. For the journal bearing, the configuration



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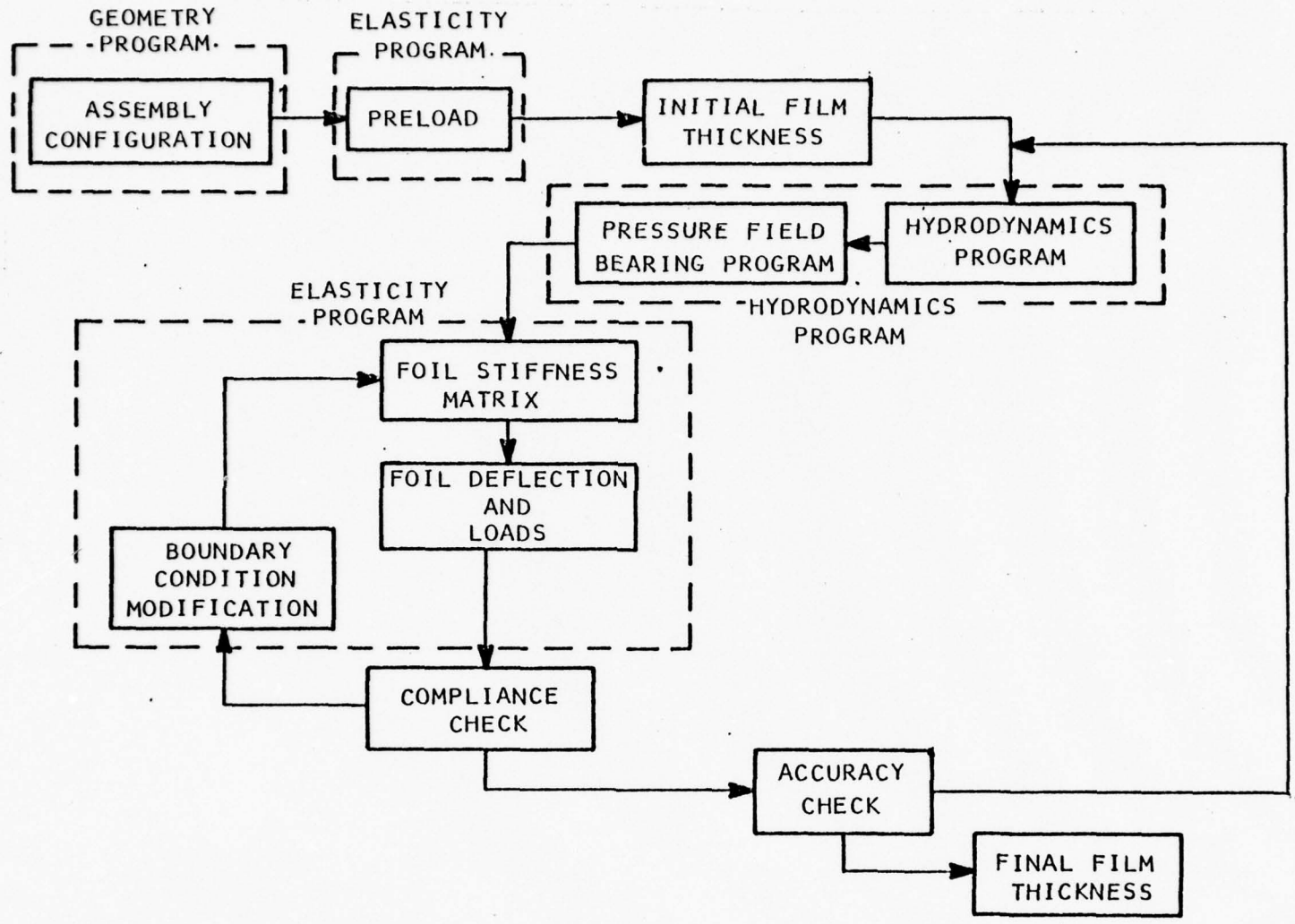



Figure 22. Elasto-Hydrodynamics Program Logic.



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of the foils may differ in the assembled state from the free form state due to foil interaction loading. Generally, the fewer number of segments, the more likely that the assembly configuration deviates from the free foil state. The assembly subroutine has been programmed to determine the assembled configuration of the foil journal bearing prior to shaft insertion. This geometry subroutine has been programmed to search for an acceptable constant curvature position at assembly. Given the free foil radius (RFF), the length of the foil (FL), the base material thickness ($t_f$), the non-structural coating thickness ($t_c$), and the bearing radius ($R_B$), the assembly subroutine seeks a foil radius $R_o$ (Figure 23) where $R' = R + t_f + t_c$. The assembly routine reports $R_o$, as well as $R_N$ (the radius to each node from the geometric center of the bearing) from which all foil deformations are measured. Figure 24 presents some typical Calcomp computer plots generated by the assembly routine for 6-, 12- and 16-segment foils.

## 3.3 Elasticity Subroutine

Figure 25 presents the details of the assembly/elasticity solution. As noted, the elasticity solution commences by obtaining the symmetric "preload" position of the foils. This is the configuration when the shaft is inserted in a zero "g" position. The program proceeds from there to obtain the foil configuration when the hydrodynamic loads are applied. Program checks provide for:

(a) Constraint or release of nodes on adjacent foils and/or contact with boundaries

(b) Constraint or release of nodes in contact with the shaft

(c) Constraint or release of nodes on the bearing housing



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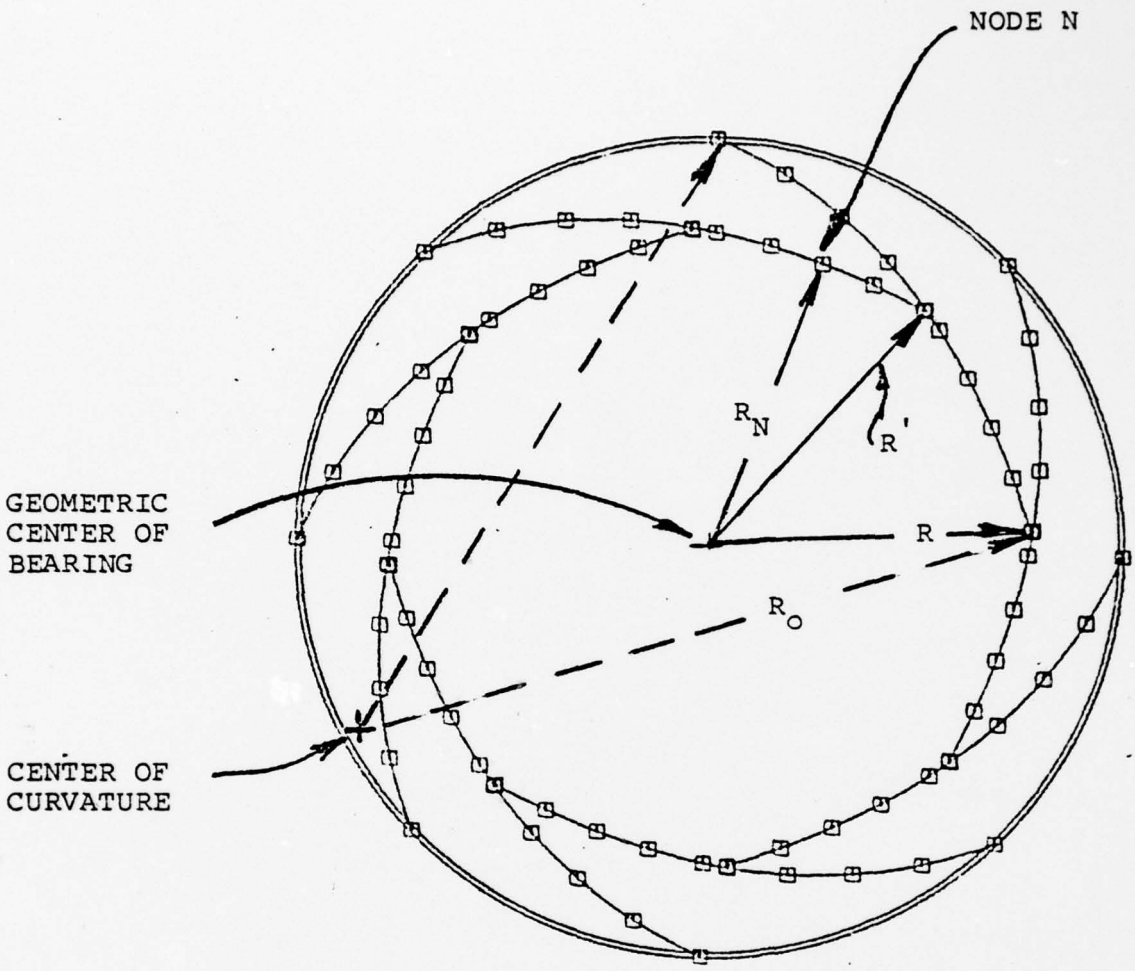
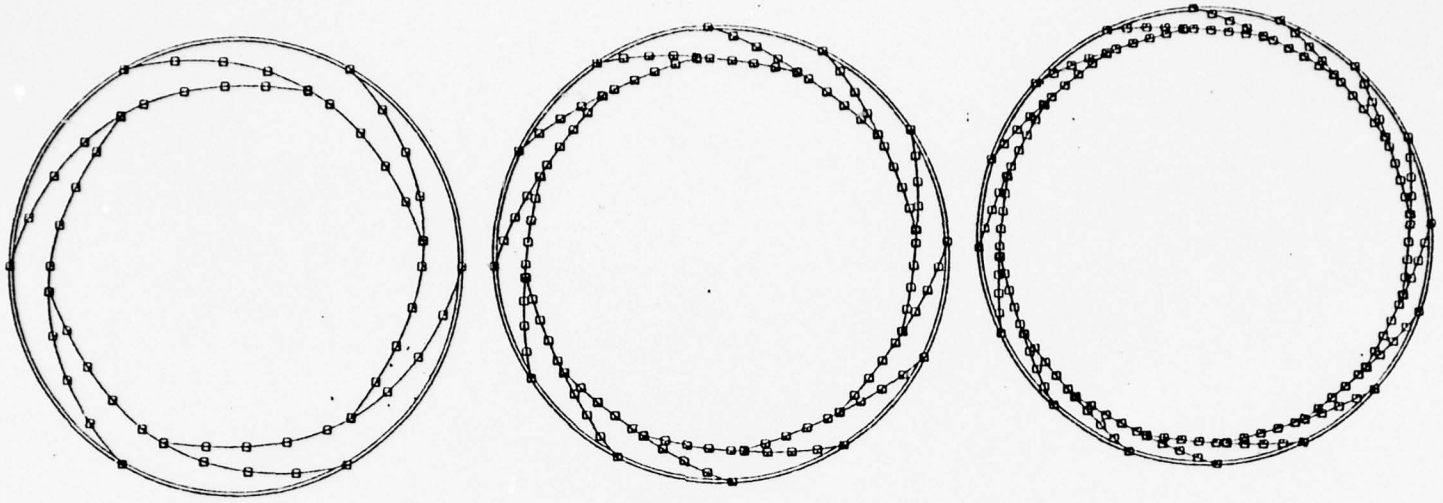



Figure 23. Assembly Position.



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6-FOIL ASSEMBLY POSITION

12-FOIL ASSEMBLY POSITION

16-FOIL ASSEMBLY POSITION

Figure 24. 6, 12, and 16-Foils Configurations.



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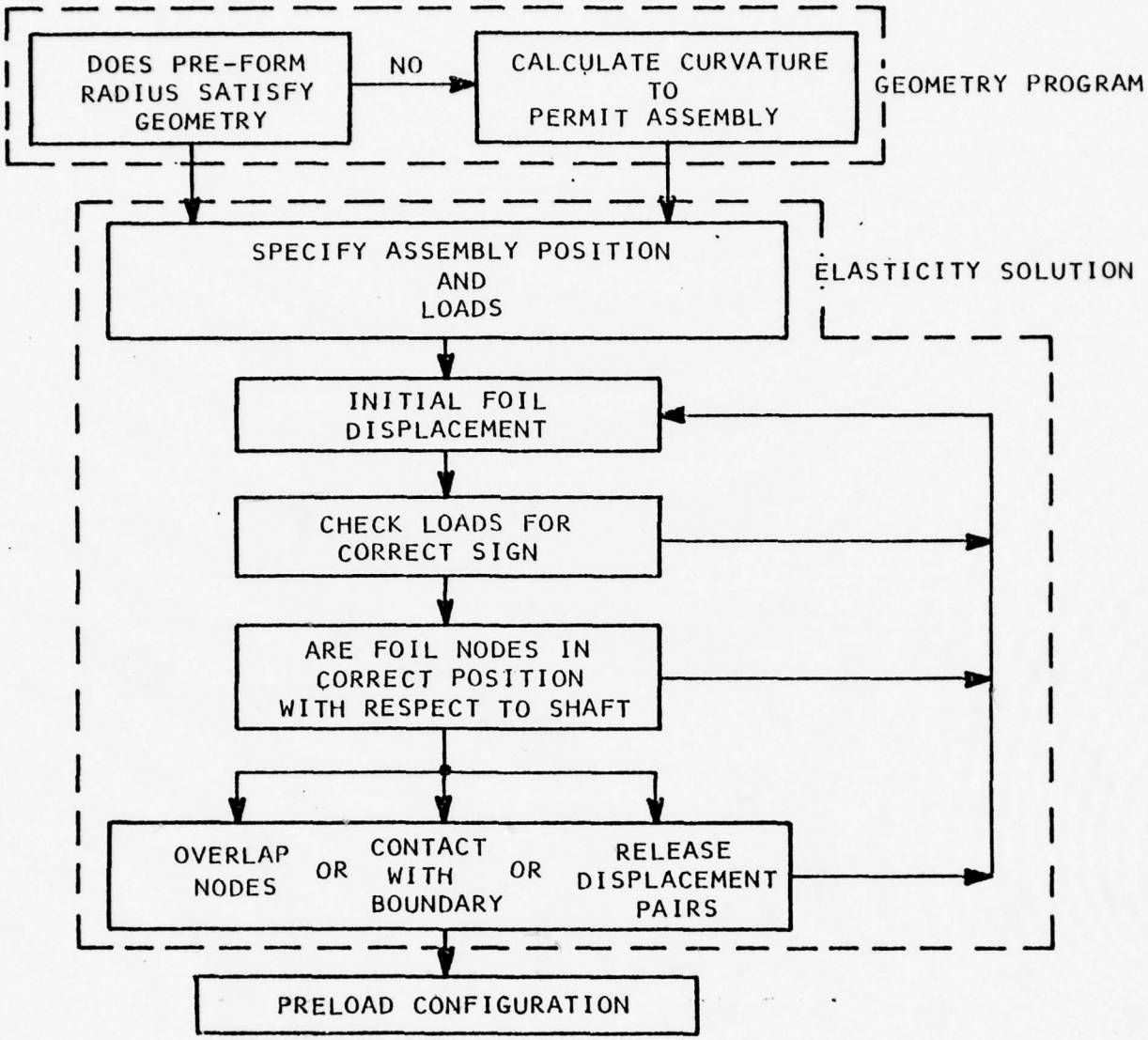



Figure 25. Assembly and Stiffness Flow Chart.



82 5 0 0

Nodal constraint is provided when displacements indicate a violation of kinematic boundaries. Release of nodes occurs when traction loads produced by constraint are no longer physically realizable.

The foil elasticity is analytically represented as a series of short curved elements with a coordinate system and sign convention (Figure 26).

By application of Castigliano's second theorem, the element and system stiffness matrices may be determined. The stiffness equation solution is provided by a straight-forward displacement matrix approach. The attachment of the foil to the bearing housing is assumed to be a "pinned joint". The difficulty in the solution is encountered when the foils are loaded. The foils begin to contact each other and encounter kinematic constraints of the journal and bearing housing. It is apparent that this provides a highly nonlinear stiffness characteristic of foil journal bearings. To deal with these problems the elasticity program generates a constraint matrix. This constraint matrix is used in a transformation of the governing equations to deflate the set of equations. By proper partitioning of this reduced set and by back transformation, the solution to the constrained equation is determined. This permits the nonlinear stiffness characteristics to be simulated.

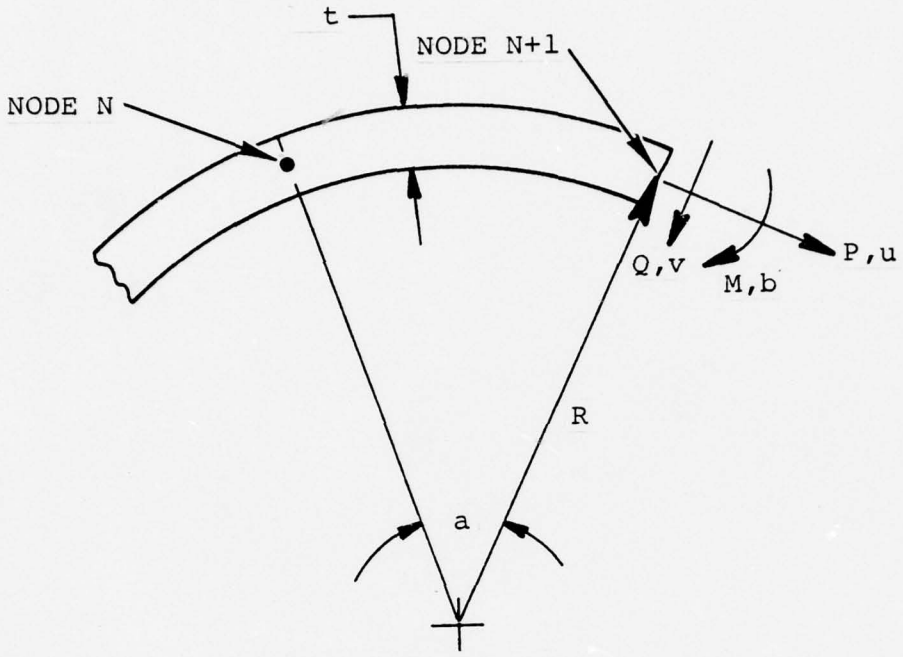
## 3.4 Hydrodynamic Analyses

The journal foil bearing subroutine termed the "Hydrodynamics Program" (Figure 22) is a finite difference solution to the Reynolds equation, based upon the assumptions that:

(a) The film clearance between the shaft and foil is small compared to the radius and length of the bearing.



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R = Radius of curvature
P = Tangential load
M = Bending moment
Q = Shear load
a = Angle which subtends the element
u = Tangential displacement
v = Flexure displacement
b = Rotation
t = Thickness

Figure 26. Foil Geometry Coordinate System.



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(b) The flow may be laminar or turbulent depending upon the local Reynolds number.

(c) Wet surfaces - no slip at bearing surfaces is permitted.

(d) The working fluid may be compressible or incompressible.

(e) The velocity gradients across the fluid film are larger than other velocity gradients.

(f) Axial and circumferential flows are permitted. Program solution for finite length bearings.

(g) Body forces, viscosity and density may vary with position in the axial and tangential directions.

(h) Nonsynchronous and squeeze film loading permitted.

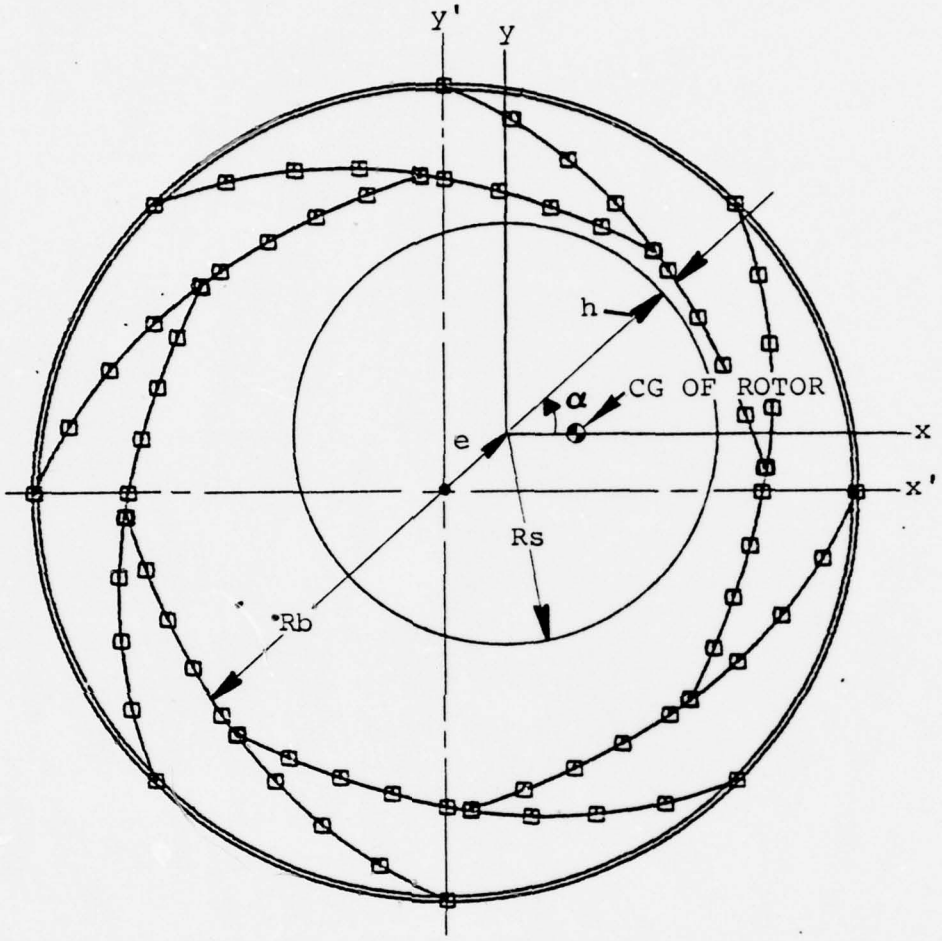
Figure 27 illustrates the foil journal bearing geometry for the hydrodynamics solution. Figure 28 illustrates the tangential and radial velocity components U and V, respectively. With this geometry defined, the compressible Reynolds equation can be expressed as:

$$\frac{\partial}{\partial x}\left[\frac{P}{k_x}\ \frac{h^3}{\mu}\left(\frac{\partial P}{\partial x} - \bar{X}\right)\right] + \frac{\partial}{\partial z}\left[\frac{P}{k_z}\ \frac{h^3}{\mu}\left(\frac{\partial P}{\partial z} - \bar{Z}\right)\right] =$$

$$6\left(P(U_o - U_1)\frac{\partial h}{\partial x} + Ph\frac{\partial}{\partial x}(U_o + U_1) + h(U_o + U_1)\frac{\partial P}{\partial x}\right)$$



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x',y' FIXED FRAME AXES
x, y WHIRL FRAME AXES

Figure 27. Foil Journal Bearing Geometry for Hydrodynamic Solution.



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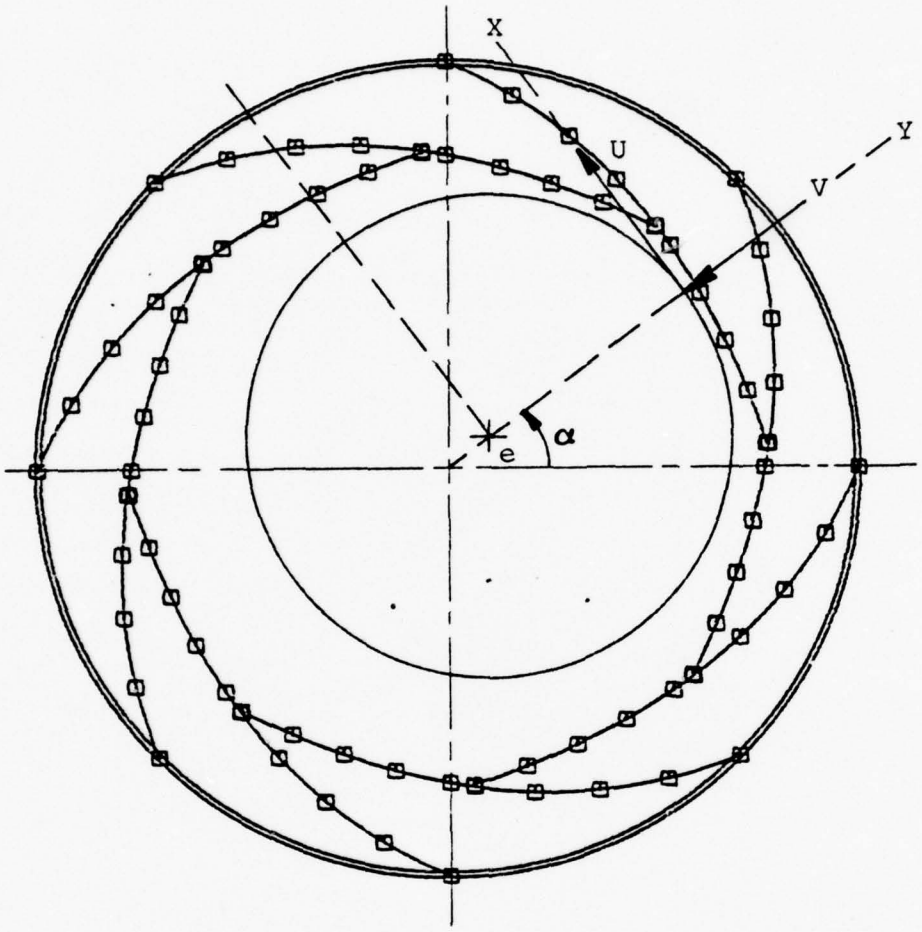



Figure 28. Foil Journal Bearing Tangential and Radial Velocity Components.



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where:

$P$ = hydrodynamic pressure

$\rho$ = Density = P/RT (Isothermal conditions)

$\bar{X}$, $\bar{Z}$ = body forces

$U_o$, $V_o$ = velocity components at shaft surface

$U_1$, $V_1$ = velocity components at foil surface

$h$ = film thickness

$\mu$ = viscosity

and the turbulence constants $k_x$ and $k_z$ are given by:

$$k_x = 12 + 0.53(K^2 R_e)^{0.725}$$

$$k_y = 12 + 0.296(K^2 R_e)^{0.65}$$

where $R_e$ is the local Reynolds Number and K is the Prandtl's mixing length.

## 3.5 Comparison of Analytical and Experimental Data for Elasticity Solution

Numerous test cases have been evaluated to demonstrate the program's capability in recognizing proper release, kinematic constraints, and foil overlap in duplicating experimental static stiffness data. A thorough examination of the elasticity program and correlation with experimental data has demonstrated the adequacy of this portion of the elasto-hydrodynamics journal bearing program. Some of these results are presented below:



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- Figure 29 illustrates a typical foil geometry and the coordinate system utilized in this study. Note that the positive direction of eccentricity (e) has been established in the direction of the positive Y axis. Accordingly, a negative value of ($F_y$) on the journal opposes a positive value of eccentricity (e). Further, a positive value of ($F_x$) encourages forward precession (whirl), whereas a negative value of ($F_x$) opposes forward whirl. The angle ($\Psi$) is a geometric parameter and is a user input option to control the displacement vector (eccentricity) direction with respect to foil geometry.

- Figure 30 shows a comparison of experimental data and analytic data for a 0.0085-in. thick 16-segment foil coated with 0.001 in. of Teflon-S. As shown, excellent correlation was achieved.

- Figure 31 is a comparison of analytic and experimental data for a 0.010-in. thick uncoated 8-segment foil. Two curves are presented; one for the displacement vector (eccentricity) directed toward the trailing edge (T.E.) of a foil, the other with the eccentricity directed midway between two trailing edges of adjacent foils. It is interesting that both experimental and analytic data demonstrate the "stiffer" curve is produced when loading is directed midway between the trailing edges of two adjacent foils.

- Figure 32 presents the data obtained for a 0.012-in. thick 12-segment foil coated with 0.001 in. of Teflon-S. Two curves for the experimental and analytic study are presented similar to those of Figure 31 for the 8-segment foil. It is noteworthy that, unlike Figure 31, the experimental curves for



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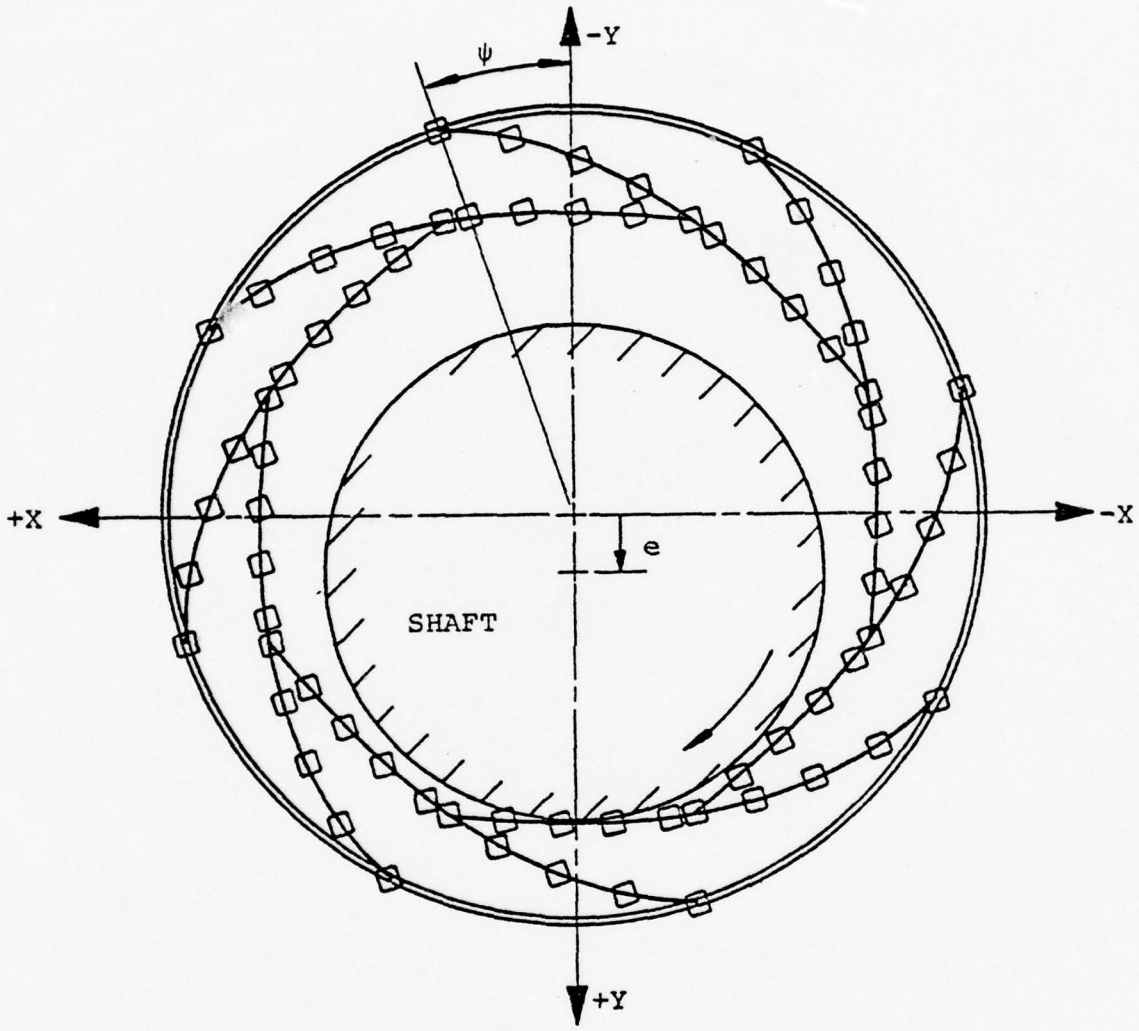



Figure 29. Geometry and Coordinate System for Elasticity Program



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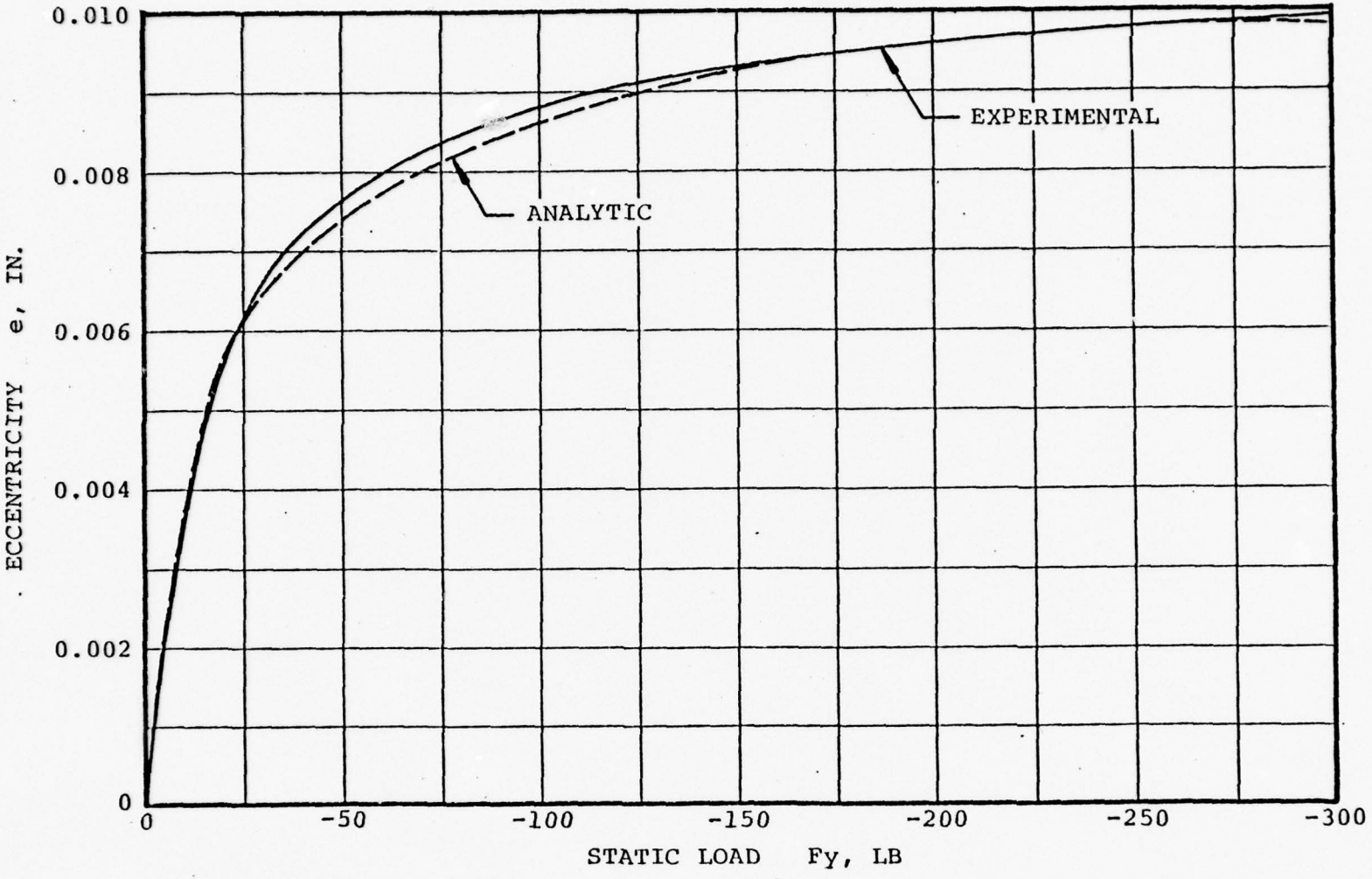



Figure 30. Sixteen-Foil Geometry Load Versus Eccentricity



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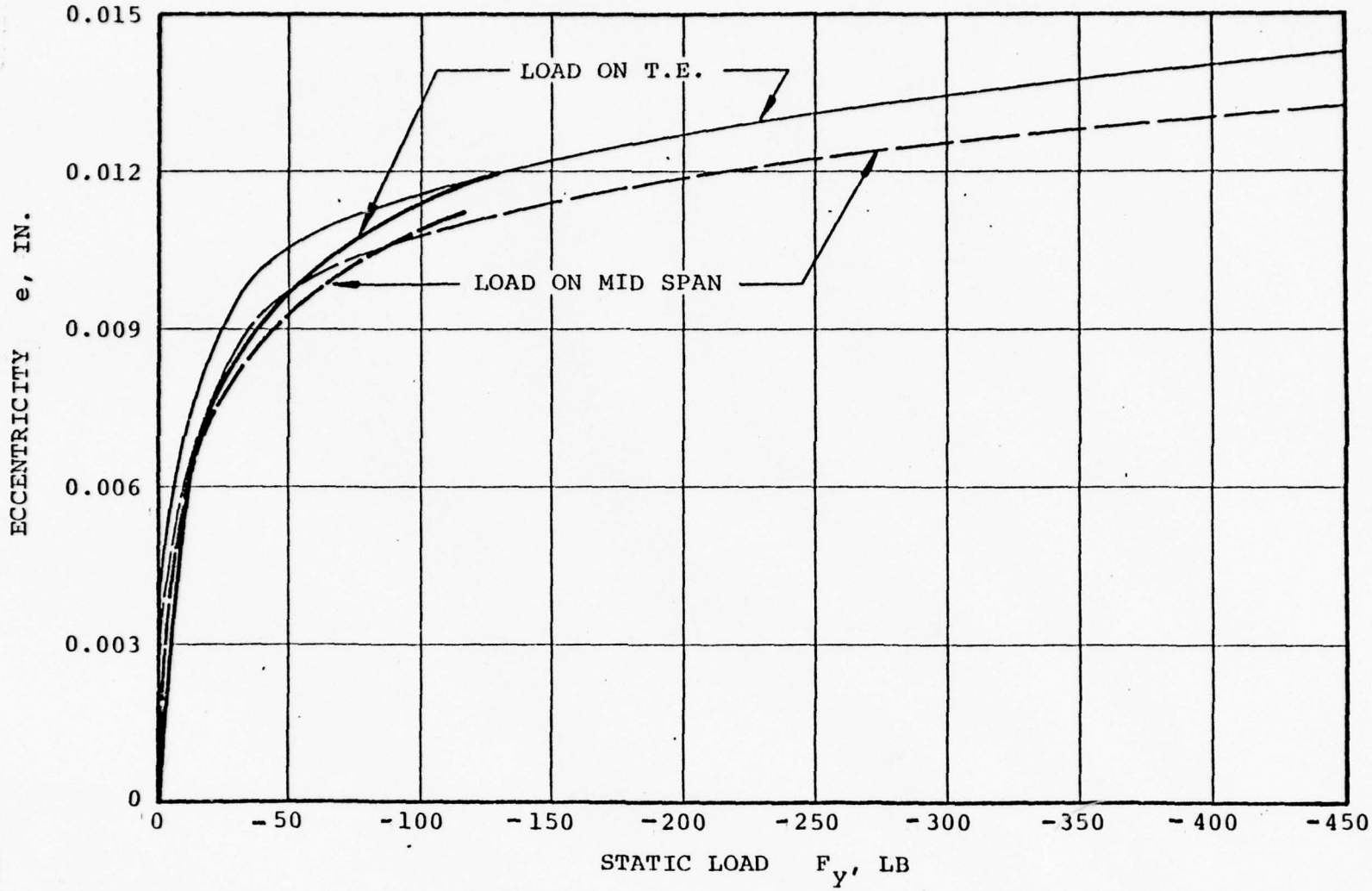



Figure 31. Eight-Segment Journal Bearing (0.010)



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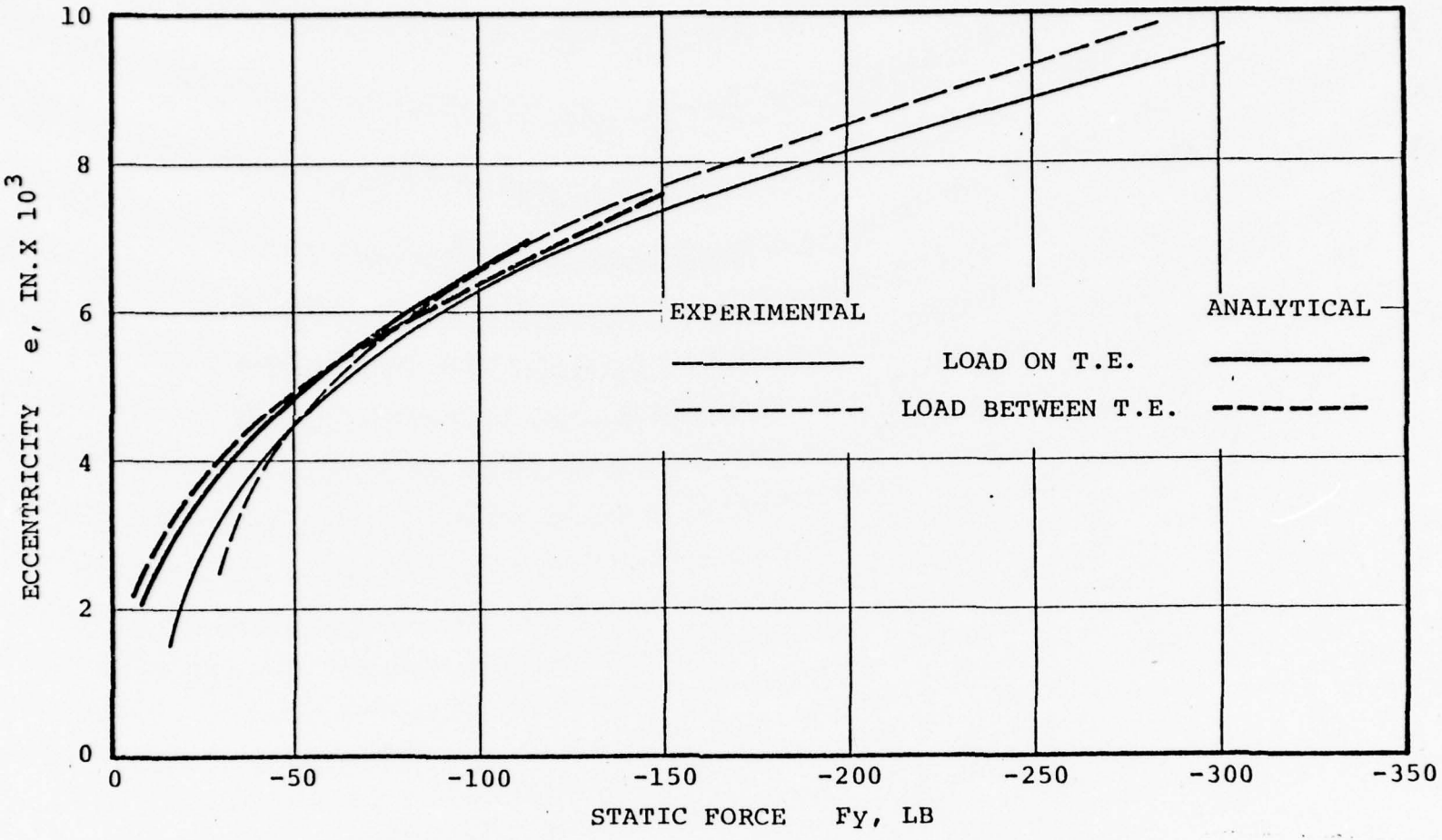



Figure 32. Twelve-Segment Foil Effect of Load Direction

loading over the trailing edge and loading between adjacent foils cross at approximately 0.005-in. eccentricity. This same characteristic is duplicated at an eccentricity of 0.006 in. for the analytic data.

- Figure 33 presents the loading obtained analytically, which represents the resultant orthogonal load $F_x$ (see Figure 29), for the 12-segment foil studied in Figure 32. The magnitude of this load is small in comparison to the load-resisting eccentricity ($F_y$) of Figure 32. It is interesting to note the apparent symmetry when the loading direction is altered.

- Figure 34 is a 12-segment design analytic study of the effect of foil length on static stiffness. The solid line represents a minimum foil length (0.010 in. less than nominal) or a foil overlap of 47.2 percent. The "stiffer" dashed curve illustrates the load versus deflection data for a maximum foil length (0.010 in. greater than nominal) or an overlap of 47.7 percent (the nominal foil overlap is 47.5 percent).

## 3.6 Foil Bearing Analytical Program Preliminary Results

Preliminary results of the nonlinear elasto-hydrodynamics program provided solutions that converged to an acceptable elasticity configuration, as well as an acceptable hydrodynamics solution.

Figure 35 represents the symmetric pressure profile for the zero eccentricity case of an 8-segment foil bearing. The computer solution verified the no-load configuration and the symmetry of pressure distribution.



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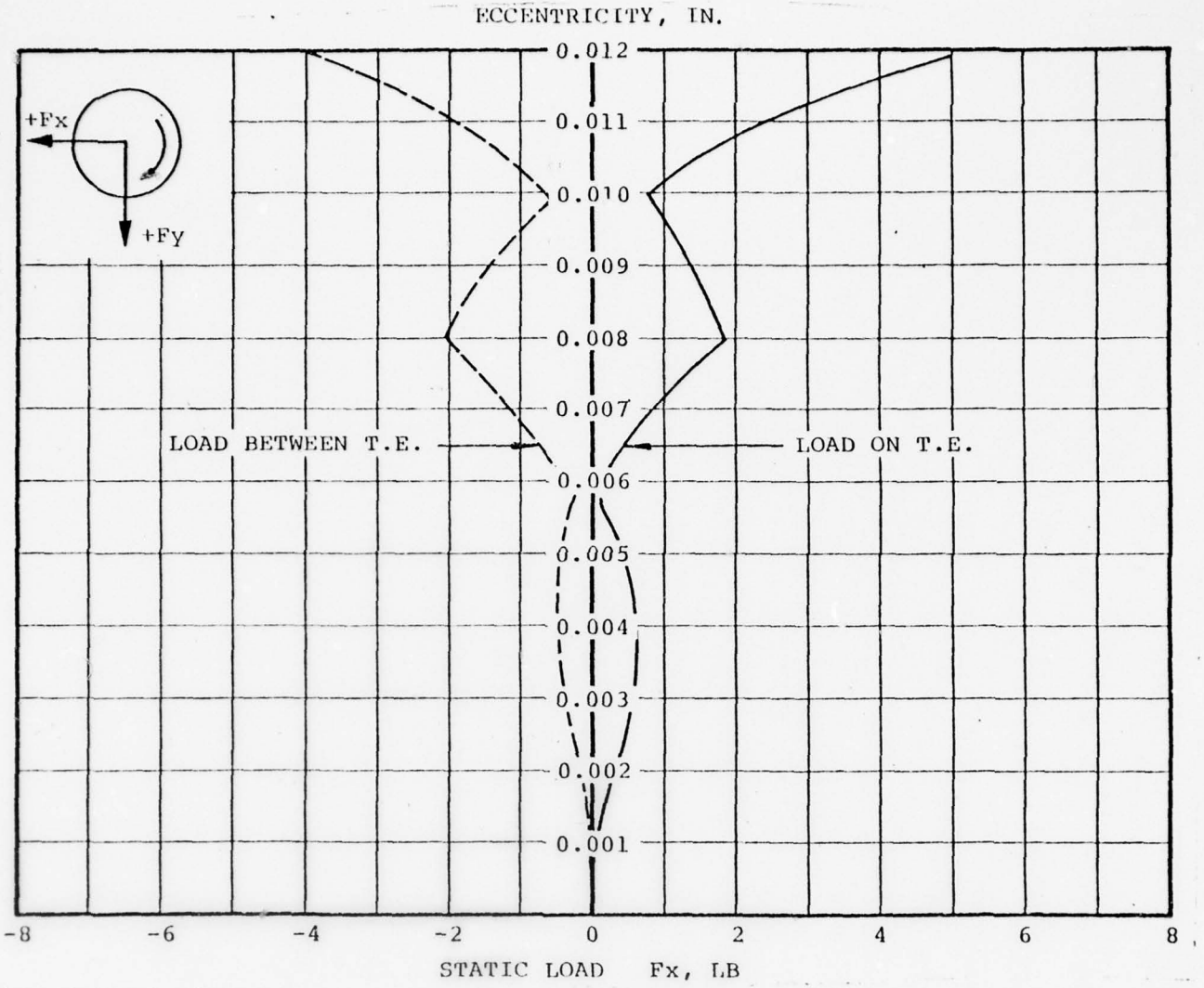



Figure 33. Twelve-Segment Foil Orthogonal Loading



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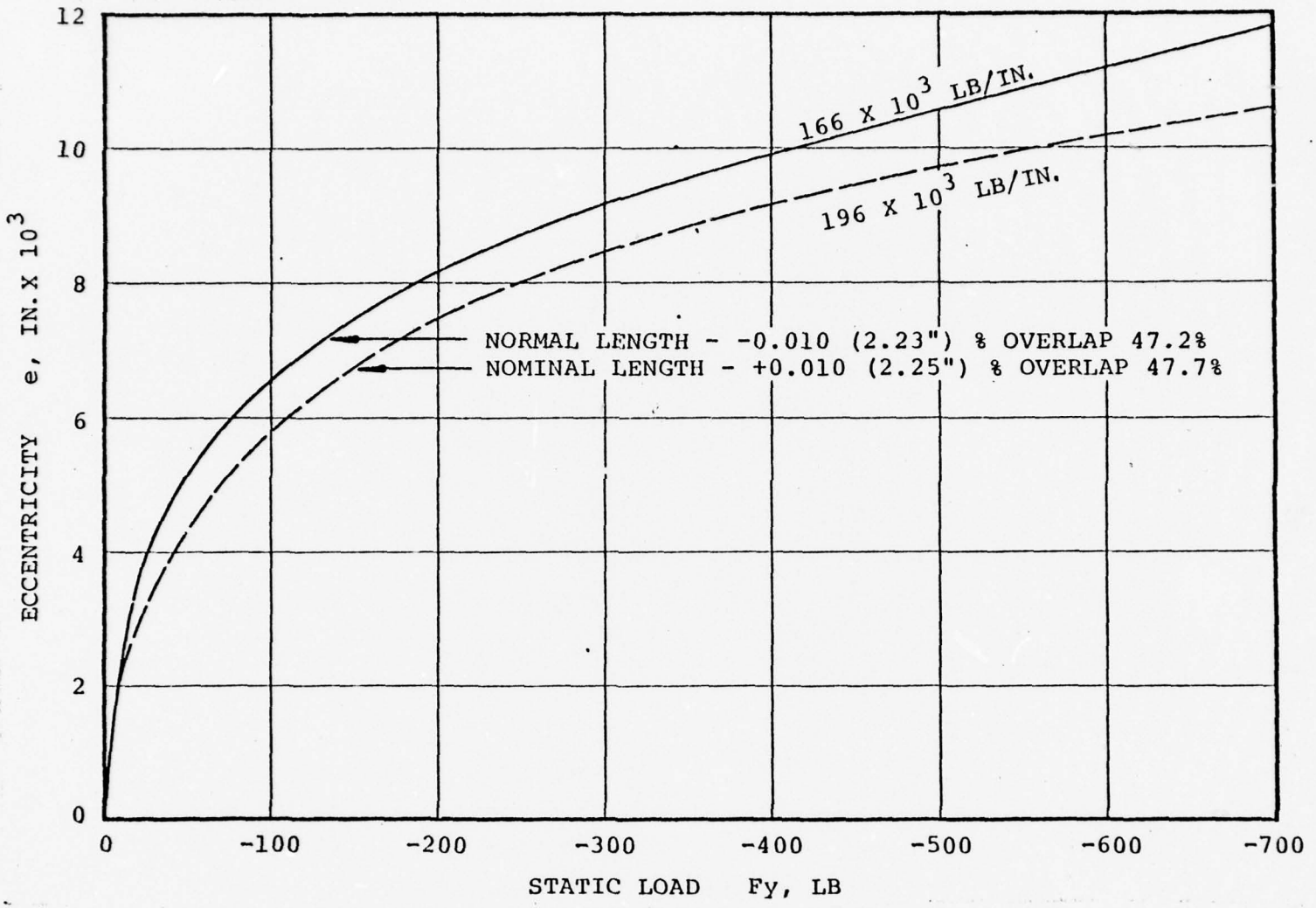
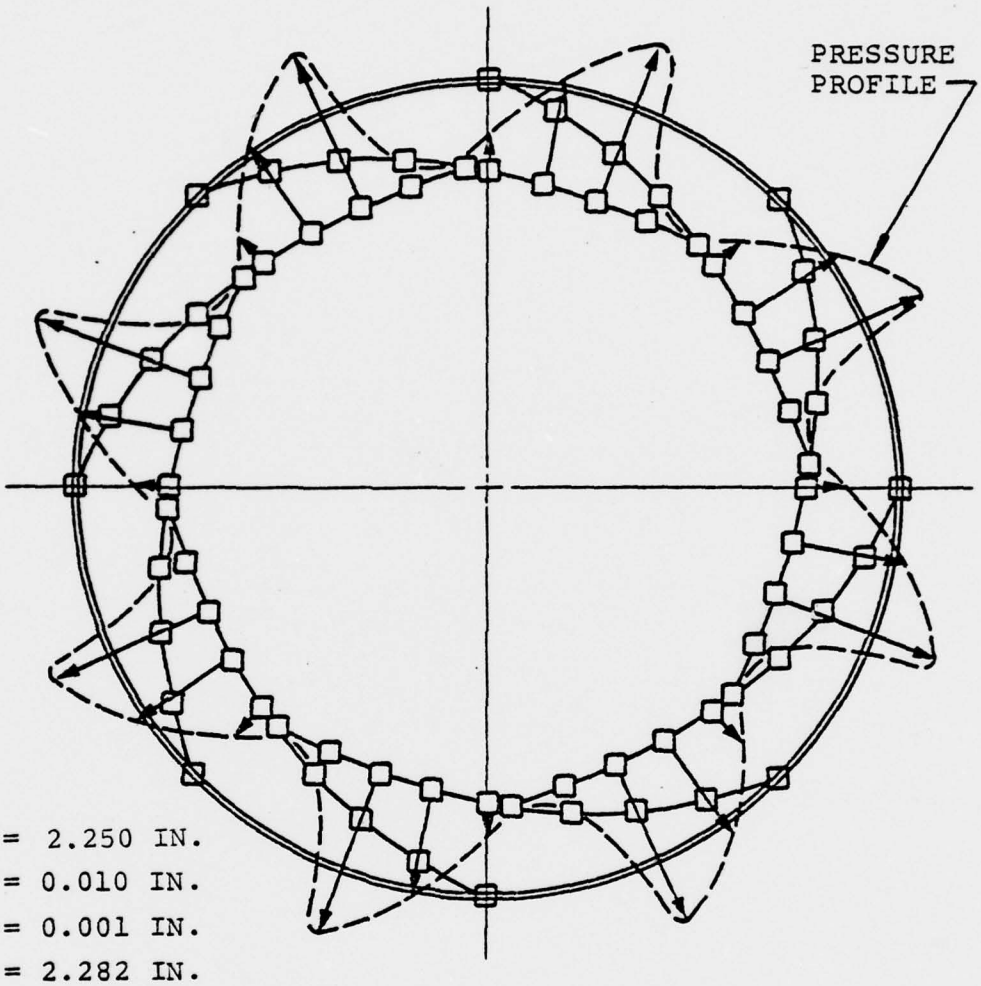



Figure 34. Twelve-Segment Foil Effect of Length




$R_s$ = 2.250 IN.
$t_f$ = 0.010 IN.
$t_c$ = 0.001 IN.
$R_b$ = 2.282 IN.
e = 0.000 IN.
F = 0.000 LB.
MINIMUM FILM = 0.0026 IN.
Pa = 15 psi
TORQUE = 2.744 LB-IN.

Figure 35. Eight-Segment Foil Center Plane Pressure Distribution



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Figure 36 is the same 8-segment configuration with an eccentricity of 0.004 in. The nonsymmetric pressure profile illustrates the pressure loading to oppose eccentricity.

## 3.7 Journal Bearing Computer Program

This paragraph presents the input data code followed by a sample configuration that has been analyzed by the CDC-6400 Program. A Fortran program listing is provided in Appendix B.

### 3.7.1 Input Data Presentation

Card 1 - Title Card - Elasticity Format (8A10)

Provided for a descriptive title of the problem being analyzed.

Card 2 - Foil Geometry Card Format (8F10.5)

Word 1 - Number of foils

Word 2 - Number of nodes per foil (6, 8 or 10)

Word 3 - Radius of bearing (inches)

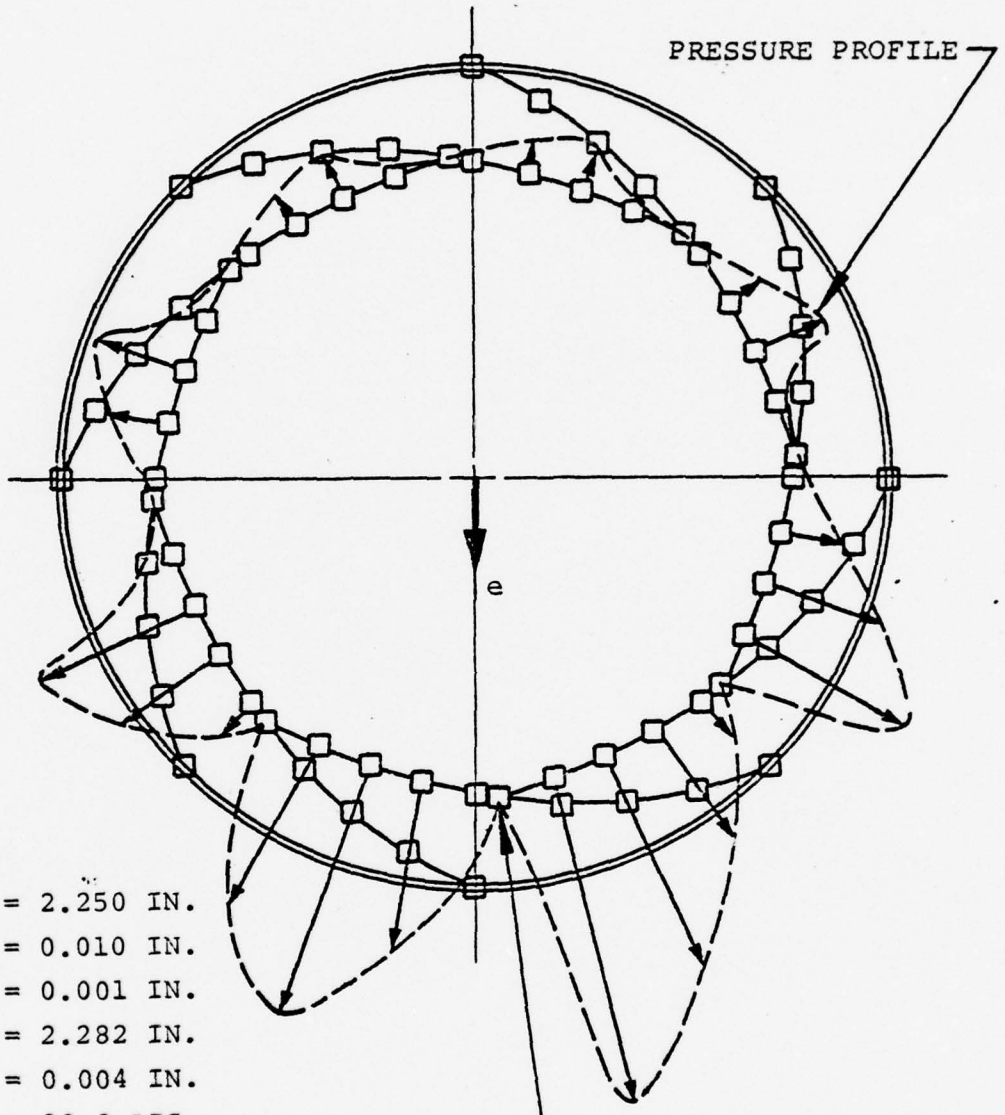
Word 4 - Axial length of bearing (inches)

Word 5 - Thickness of elastic foil base metal (inches)

Word 6 - Thickness of nonstructural coating (inches)

Word 7 - Total arc length of foil (inches)

Word 8 - Free foil radius (inches)




$R_s$ = 2.250 IN.
$t_f$ = 0.010 IN.
$t_c$ = 0.001 IN.
$R_b$ = 2.282 IN.
e = 0.004 IN.
F = 22.3 LBS.
MINIMUM FILM = 0.00007 IN.
Pa = 15 psi
TORQUE = 3.36 LB-IN.

Figure 36. Eight-Segment Foil Center Plane Pressure Distribution



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Card 3 - Plotting Card for Future Program Development

"Leave Blank"

Card 4 - Modulus of Elasticity Card Format (F10.0)

Word 1 - Foil modulus of elasticity (psi x $10^{-6}$)

Card 5 - Shaft Radius Card Format (F10.0)

Word 1 - Shaft radius (inches)

Card 6 - Eccentricity Control Card Format (3F10.0)

Word 1 - Final eccentricity (inches)

Word 2 - Increment of eccentricity (inches)

Word 3 - Initial eccentricity (inches)

Card 7 - Attitude Control Card Format (F10.0)

Word 1 - Angle ($\Psi$) of Figure 29 (Radians)

Card 8 - Title Card - Hydrodynamics Program Format (8A10)

Card 9 - Fluid Definition Card Format (6E12.3)

Word 1 - Fluid Density (lbs/in.$^3$)

Word 2 - Fluid Viscosity (lbs-sec/in.$^2$)

Word 3 - Leave blank for foil bearing solution

Word 4 - Relaxation Factor for Hydrodynamics - Elasticity Iterations (Recommend 0.25)



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Word 5 - Permissible Convergence Error for Solution (Recommend 0.1 to 0.25)

Card 10 - Boundary Conditions Card Format (5E12.3, F6.0)

Word 1 - Boundary Pressure Row 1 (psi) (Rows made by longitudinal lines parallel to centerline)

Word 2 - Boundary Pressure Last Row (psi)

Word 3 - Vapor Pressure of Fluid (psi)

Word 4 - Error Permissible for Pressure Iterations of Hydrodynamic Solution (Recommend 1.0)

Word 5 - Factor to Over-or-Under-Relax Pressure Iterations (Recommend 1.0)

Word 6 - Number of Iterations for Extrapolation (Recommend 5.0)

Card 11 - Bearing Kinematics Card Format (6E12.3)

Word 1 - Spin Speed of Shaft (rpm)

Word 2 - Whirl Fraction (Multiplied by Spin Speed to Obtain Whirl speed - a value of 1.0 indicates synchronous whirl)

Word 3 - Leave Blank

Word 4 - Time Derivative of Eccentricity (in/sec)

Word 5 - Value of $\alpha$ (Figure 27) (Degrees)

Word 6 - Time Derivative of $\alpha$ (rpm)



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Card 12 - Hydrodynamic Control Card  Format (18I4)

| | | |
|---|---|---|
| Word 1 | Number of Axial Rows | |
| Word 2 | Number of Circumferential Columns | |
| Word 3 | Leave Blank | |
| Word 4 | = 500 | |
| Word 5 | Leave Blank | |
| Word 6 | = 1 | These values must be specified as indicated for proper operation of the Hydrodynamic Solution for Foil Bearing analysis |
| Word 7 | = 2 | |
| Word 8 | = 1 | |
| Word 9 | = 3 | |
| Word 10 | = 2 | |
| Word 11 | = 2 | |
| Word 12 | = 2 | |
| Word 13 | = 1 | |
| Word 14 | = 2 | |
| Word 15 | = 2 | |
| Word 16 | = 1 | |
| Word 17 | = 2 | |
| Word 18 | = 3 | |

Card 13 - Geometry Card  Format (2I5, E12.3, I5, I2)

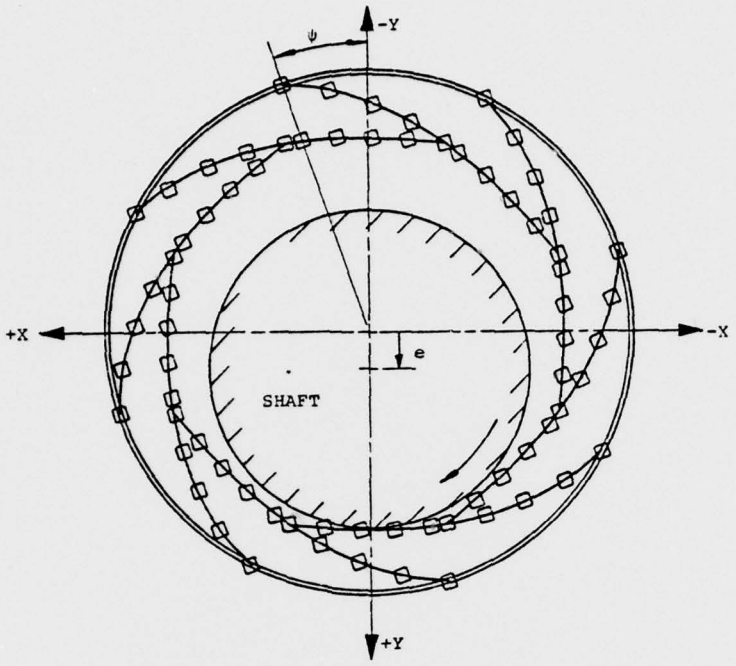
Word 1 - Row Number (I)
Word 2 - Column Number (J)
Word 3 - Specified Pressure at (I, J)
Word 4 - Code
0 = Interior Point
1 = Boundary Point Number Iterated
Word 5 - Next Card Code
1 = Continue reading
2 = Last Card

### 3.7.2 Sample Problem

To illustrate the use of this computer code, the computer input and results for the geometry depicted in Figure 37, are presented on the following pages.



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No. of Elasticity Nodes = 80
Hydrodynamic Grid = 35 x 5
No. of Foils = 8
No. of Elasticity Nodes/Foil = 10
Bearing Radius = 2.282 in.
Axial Length = 6.000 in.
Foil Thickness = 0.010 in.
Coating Thickness = 0.001 in.
Arc Length of Foil = 3.40 in.
Free Form Radius = 3.00 in.
P = 15 psi (Ambient)
Eccentricity = 0.004 in.
Spin Speed = 33,000 rpm
Viscosity = $0.42 \times 10^{-8}$ lbs/sec/in$^2$
Density of Fluid = $2.29 \times 10^{-5}$ lbs/in$^3$
Modulus of Elasticity = $30 \times 10^5$ psi
$\Psi$ = 0.0 Radians

Figure 37. Sample Problem Geometry



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SAMPLE INPUT FOR FOIL JOURNAL BEARING PROGRAM

```
8 FOIL TEST CASE                                                              CARD 1
8.        10.       2.282      5.        0.010     0.001     3.4       3.0  CARD 2
0                                                                             CARD 3
30.                                                                           CARD 4
2.25                                                                          CARD 5
.004      .004      .004                                                      CARD 6
0.0                                                                           CARD 7
8 FOIL TEST CASE                                                              CARD 8
2.29      E=50.42   E=0E6.          0.25      0.25                            CARD 9
0.          15.       0.            1.        1.0       5.0                 CARD 10
33000.                                                                        CARD 11
    5  35     500      1  2  1  3  2  2  2  1  2  2  1  2  3                 CARD 12
    1   1  15.0          1  1
    2   1  15.0          1  1
    3   1  15.0          1  1
    4   1  15.0          1  1                                               CARD 13
    5   1  15.0          1  1
    1  35  15.0          1  1
    2  35  15.0          1  1
    3  35  15.0          1  1
    4  35  15.0          1  1
    5  35  15.0          1  2
```



62500

# FOIL 1

I = 1

| J | CLEARANCE | FILM THICK | VISCOSITY | PRESSURE | CODE | J | CLEARANCE | FILM THICK | VISCOSITY | PRESSURE | CODE |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | .13812E-01 | .16809E-01 | .42000E-08 | .15000E+02 | 1 | 2 | .12596E-01 | .16020E-01 | .42000E-08 | .15079E+02 | 0 |
| 3 | .11484E-01 | .15212E-01 | .42000E-08 | .15164E+02 | 0 | 4 | .10483E-01 | .14412E-01 | .42000E-08 | .15256E+02 | 0 |
| 5 | .95919E-02 | .13645E-01 | .42000E-08 | .15356E+02 | 0 | 6 | .88105E-02 | .12926E-01 | .42000E-08 | .15463E+02 | 0 |
| 7 | .81341E-02 | .12268E-01 | .42000E-08 | .15578E+02 | 0 | 8 | .75562E-02 | .11677E-01 | .42000E-08 | .15701E+02 | 0 |
| 9 | .70683E-02 | .11156E-01 | .42000E-08 | .15830E+02 | 0 | 10 | .66601E-02 | .10703E-01 | .42000E-08 | .15966E+02 | 0 |
| 11 | .63202E-02 | .10313E-01 | .42000E-08 | .16106E+02 | 0 | 12 | .60363E-02 | .99804E-02 | .42000E-08 | .16251E+02 | 0 |
| 13 | .57954E-02 | .96948E-02 | .42000E-08 | .16398E+02 | 0 | 14 | .55846E-02 | .94454E-02 | .42000E-08 | .16548E+02 | 0 |
| 15 | .53907E-02 | .92203E-02 | .42000E-08 | .16697E+02 | 0 | 16 | .52015E-02 | .90069E-02 | .42000E-08 | .16847E+02 | 0 |
| 17 | .50053E-02 | .87928E-02 | .42000E-08 | .16995E+02 | 0 | 18 | .47919E-02 | .85659E-02 | .42000E-08 | .17142E+02 | 0 |
| 19 | .45525E-02 | .83154E-02 | .42000E-08 | .17284E+02 | 0 | 20 | .42801E-02 | .80320E-02 | .42000E-08 | .17424E+02 | 0 |
| 21 | .39704E-02 | .77086E-02 | .42000E-08 | .17557E+02 | 0 | 22 | .36214E-02 | .73407E-02 | .42000E-08 | .17684E+02 | 0 |
| 23 | .32343E-02 | .69271E-02 | .42000E-08 | .17799E+02 | 0 | 24 | .28134E-02 | .64703E-02 | .42000E-08 | .17901E+02 | 0 |
| 25 | .23669E-02 | .59772E-02 | .42000E-08 | .17979E+02 | 0 | 26 | .19071E-02 | .54596E-02 | .42000E-08 | .18026E+02 | 0 |
| 27 | .14506E-02 | .49343E-02 | .42000E-08 | .18020E+02 | 0 | 28 | .10187E-02 | .44244E-02 | .42000E-08 | .17942E+02 | 0 |
| 29 | .63815E-03 | .39592E-02 | .42000E-08 | .17751E+02 | 0 | 30 | .34081E-03 | .35752E-02 | .42000E-08 | .17418E+02 | 0 |
| 31 | .16457E-03 | .33162E-02 | .42000E-08 | .16920E+02 | 0 | 32 | .15348E-03 | .32341E-02 | .42000E-08 | .16306E+02 | 0 |
| 33 | .35811E-03 | .33895E-02 | .42000E-08 | .15698E+02 | 0 | 34 | .83595E-03 | .38520E-02 | .42000E-08 | .15243E+02 | 0 |
| 35 | .16518E-02 | .47009E-02 | .42000E-08 | .15000E+02 | 1 | | | | | | |

I = 2

| J | CLEARANCE | FILM THICK | VISCOSITY | PRESSURE | CODE | J | CLEARANCE | FILM THICK | VISCOSITY | PRESSURE | CODE |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | .13812E-01 | .16809E-01 | .42000E-08 | .15000E+02 | 1 | 2 | .12596E-01 | .16020E-01 | .42000E-08 | .15078E+02 | 0 |
| 3 | .11484E-01 | .15212E-01 | .42000E-08 | .15161E+02 | 0 | 4 | .10483E-01 | .14412E-01 | .42000E-08 | .15252E+02 | 0 |
| 5 | .95919E-02 | .13645E-01 | .42000E-08 | .15349E+02 | 0 | 6 | .88105E-02 | .12926E-01 | .42000E-08 | .15454E+02 | 0 |
| 7 | .81341E-02 | .12268E-01 | .42000E-08 | .15567E+02 | 0 | 8 | .75562E-02 | .11677E-01 | .42000E-08 | .15687E+02 | 0 |
| 9 | .70683E-02 | .11156E-01 | .42000E-08 | .15813E+02 | 0 | 10 | .66601E-02 | .10703E-01 | .42000E-08 | .15945E+02 | 0 |
| 11 | .63202E-02 | .10313E-01 | .42000E-08 | .16082E+02 | 0 | 12 | .60363E-02 | .99804E-02 | .42000E-08 | .16223E+02 | 0 |
| 13 | .57954E-02 | .96948E-02 | .42000E-08 | .16366E+02 | 0 | 14 | .55846E-02 | .94454E-02 | .42000E-08 | .16513E+02 | 0 |
| 15 | .53907E-02 | .92203E-02 | .42000E-08 | .16658E+02 | 0 | 16 | .52015E-02 | .90069E-02 | .42000E-08 | .16805E+02 | 0 |
| 17 | .50053E-02 | .87928E-02 | .42000E-08 | .16949E+02 | 0 | 18 | .47919E-02 | .85659E-02 | .42000E-08 | .17094E+02 | 0 |
| 19 | .45525E-02 | .83154E-02 | .42000E-08 | .17233E+02 | 0 | 20 | .42801E-02 | .80320E-02 | .42000E-08 | .17372E+02 | 0 |
| 21 | .39704E-02 | .77086E-02 | .42000E-08 | .17502E+02 | 0 | 22 | .36214E-02 | .73407E-02 | .42000E-08 | .17629E+02 | 0 |
| 23 | .32343E-02 | .69271E-02 | .42000E-08 | .17742E+02 | 0 | 24 | .28134E-02 | .64703E-02 | .42000E-08 | .17844E+02 | 0 |
| 25 | .23669E-02 | .59772E-02 | .42000E-08 | .17922E+02 | 0 | 26 | .19071E-02 | .54596E-02 | .42000E-08 | .17969E+02 | 0 |
| 27 | .14506E-02 | .49343E-02 | .42000E-08 | .17965E+02 | 0 | 28 | .10187E-02 | .44244E-02 | .42000E-08 | .17889E+02 | 0 |
| 29 | .63815E-03 | .39592E-02 | .42000E-08 | .17702E+02 | 0 | 30 | .34081E-03 | .35752E-02 | .42000E-08 | .17374E+02 | 0 |
| 31 | .16457E-03 | .33162E-02 | .42000E-08 | .16885E+02 | 0 | 32 | .15348E-03 | .32341E-02 | .42000E-08 | .16281E+02 | 0 |
| 33 | .35811E-03 | .33895E-02 | .42000E-08 | .15683E+02 | 0 | 34 | .83595E-03 | .38520E-02 | .42000E-08 | .15237E+02 | 0 |
| 35 | .16518E-02 | .47009E-02 | .42000E-08 | .15000E+02 | 1 | | | | | | |

I = 3

| J | CLEARANCE | FILM THICK | VISCOSITY | PRESSURE | CODE | J | CLEARANCE | FILM THICK | VISCOSITY | PRESSURE | CODE |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | .13812E-01 | .16809E-01 | .42000E-08 | .15000E+02 | 1 | 2 | .12596E-01 | .16020E-01 | .42000E-08 | .15072E+02 | 0 |
| 3 | .11484E-01 | .15212E-01 | .42000E-08 | .15150E+02 | 0 | 4 | .10483E-01 | .14412E-01 | .42000E-08 | .15233E+02 | 0 |
| 5 | .95919E-02 | .13645E-01 | .42000E-08 | .15323E+02 | 0 | 6 | .88105E-02 | .12926E-01 | .42000E-08 | .15419E+02 | 0 |
| 7 | .81341E-02 | .12268E-01 | .42000E-08 | .15521E+02 | 0 | 8 | .75562E-02 | .11677E-01 | .42000E-08 | .15630E+02 | 0 |
| 9 | .70683E-02 | .11156E-01 | .42000E-08 | .15743E+02 | 0 | 10 | .66601E-02 | .10703E-01 | .42000E-08 | .15862E+02 | 0 |
| 11 | .63202E-02 | .10313E-01 | .42000E-08 | .15984E+02 | 0 | 12 | .60363E-02 | .99804E-02 | .42000E-08 | .16111E+02 | 0 |
| 13 | .57954E-02 | .96948E-02 | .42000E-08 | .16239E+02 | 0 | 14 | .55846E-02 | .94454E-02 | .42000E-08 | .16370E+02 | 0 |
| 15 | .53907E-02 | .92203E-02 | .42000E-08 | .16501E+02 | 0 | 16 | .52015E-02 | .90069E-02 | .42000E-08 | .16634E+02 | 0 |
| 17 | .50053E-02 | .87928E-02 | .42000E-08 | .16766E+02 | 0 | 18 | .47919E-02 | .85659E-02 | .42000E-08 | .16899E+02 | 0 |
| 19 | .45525E-02 | .83154E-02 | .42000E-08 | .17025E+02 | 0 | 20 | .42801E-02 | .80320E-02 | .42000E-08 | .17157E+02 | 0 |
| 21 | .39704E-02 | .77086E-02 | .42000E-08 | .17283E+02 | 0 | 22 | .36214E-02 | .73407E-02 | .42000E-08 | .17400E+02 | 0 |
| 23 | .32343E-02 | .69271E-02 | .42000E-08 | .17508E+02 | 0 | 24 | .28134E-02 | .64703E-02 | .42000E-08 | .17608E+02 | 0 |
| 25 | .23669E-02 | .59772E-02 | .42000E-08 | .17685E+02 | 0 | 26 | .19071E-02 | .54596E-02 | .42000E-08 | .17735E+02 | 0 |



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| | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| 27 | .14506E-02 | .49343E-02 | .42000E-08 | .17736E+02 | 0 | 28 | .10187E-02 | .44244E-02 | .42000E-08 | .17670E+02 | 0 |
| 29 | .63815E-03 | .39592E-02 | .42000E-08 | .17499E+02 | 0 | 30 | .34081E-03 | .35752E-02 | .42000E-08 | .17194E+02 | 0 |
| 31 | .16457E-03 | .33162E-02 | .42000E-08 | .16737E+02 | 0 | 32 | .15348E-03 | .32341E-02 | .42000E-08 | .16173E+02 | 0 |
| 33 | .35811E-03 | .33895E-02 | .42000E-08 | .15618E+02 | 0 | 34 | .83595E-03 | .38520E-02 | .42000E-08 | .15210E+02 | 0 |
| 35 | .16518E-02 | .47009E-02 | .42000E-08 | .15000E+02 | 1 | | | | | | |

I = 4

| J | CLEARANCE | FILM THICK | VISCOSITY | PRESSURE | CODE | J | CLEARANCE | FILM THICK | VISCOSITY | PRESSURE | CODE |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | .13812E-01 | .16809E-01 | .42000E-08 | .15000E+02 | 1 | 2 | .12596E-01 | .16020E-01 | .42000E-08 | .15057E+02 | 0 |
| 3 | .11484E-01 | .15212E-01 | .42000E-08 | .15116E+02 | 0 | 4 | .10483E-01 | .14412E-01 | .42000E-08 | .15180E+02 | 0 |
| 5 | .95919E-02 | .13645E-01 | .42000E-08 | .15247E+02 | 0 | 6 | .88105E-02 | .12926E-01 | .42000E-08 | .15317E+02 | 0 |
| 7 | .81341E-02 | .12268E-01 | .42000E-08 | .15390E+02 | 0 | 8 | .75562E-02 | .11677E-01 | .42000E-08 | .15467E+02 | 0 |
| 9 | .70683E-02 | .11156E-01 | .42000E-08 | .15546E+02 | 0 | 10 | .66601E-02 | .10703E-01 | .42000E-08 | .15628E+02 | 0 |
| 11 | .63202E-02 | .10313E-01 | .42000E-08 | .15711E+02 | 0 | 12 | .60363E-02 | .99804E-02 | .42000E-08 | .15798E+02 | 0 |
| 13 | .57954E-02 | .96948E-02 | .42000E-08 | .15885E+02 | 0 | 14 | .55846E-02 | .94454E-02 | .42000E-08 | .15975E+02 | 0 |
| 15 | .53907E-02 | .92203E-02 | .42000E-08 | .16066E+02 | 0 | 16 | .52015E-02 | .90069E-02 | .42000E-08 | .16161E+02 | 0 |
| 17 | .50053E-02 | .87928E-02 | .42000E-08 | .16256E+02 | 0 | 18 | .47919E-02 | .85659E-02 | .42000E-08 | .16355E+02 | 0 |
| 19 | .45525E-02 | .83154E-02 | .42000E-08 | .16452E+02 | 0 | 20 | .42801E-02 | .80320E-02 | .42000E-08 | .16553E+02 | 0 |
| 21 | .39704E-02 | .77086E-02 | .42000E-08 | .16650E+02 | 0 | 22 | .36214E-02 | .73407E-02 | .42000E-08 | .16748E+02 | 0 |
| 23 | .32343E-02 | .69271E-02 | .42000E-08 | .16839E+02 | 0 | 24 | .28134E-02 | .64703E-02 | .42000E-08 | .16926E+02 | 0 |
| 25 | .23669E-02 | .59772E-02 | .42000E-08 | .16997E+02 | 0 | 26 | .19071E-02 | .54596E-02 | .42000E-08 | .17049E+02 | 0 |
| 27 | .14506E-02 | .49343E-02 | .42000E-08 | .17061E+02 | 0 | 28 | .10187E-02 | .44244E-02 | .42000E-08 | .17022E+02 | 0 |
| 29 | .63815E-03 | .39592E-02 | .42000E-08 | .16895E+02 | 0 | 30 | .34081E-03 | .35752E-02 | .42000E-08 | .16660E+02 | 0 |
| 31 | .16457E-03 | .33162E-02 | .42000E-08 | .16299E+02 | 0 | 32 | .15348E-03 | .32341E-02 | .42000E-08 | .15856E+02 | 0 |
| 33 | .35811E-03 | .33895E-02 | .42000E-08 | .15429E+02 | 0 | 34 | .83595E-03 | .38520E-02 | .42000E-08 | .15131E+02 | 0 |
| 35 | .16518E-02 | .47009E-02 | .42000E-08 | .15000E+02 | 1 | | | | | | |

I = 5

| J | CLEARANCE | FILM THICK | VISCOSITY | PRESSURE | CODE | J | CLEARANCE | FILM THICK | VISCOSITY | PRESSURE | CODE |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | .13812E-01 | .16809E-01 | .42000E-08 | .15000E+02 | 1 | 2 | .12596E-01 | .16020E-01 | .42000E-08 | .15000E+02 | 1 |
| 3 | .11484E-01 | .15212E-01 | .42000E-08 | .15000E+02 | 1 | 4 | .10483E-01 | .14412E-01 | .42000E-08 | .15000E+02 | 1 |
| 5 | .95919E-02 | .13645E-01 | .42000E-08 | .15000E+02 | 1 | 6 | .88105E-02 | .12926E-01 | .42000E-08 | .15000E+02 | 1 |
| 7 | .81341E-02 | .12268E-01 | .42000E-08 | .15000E+02 | 1 | 8 | .75562E-02 | .11677E-01 | .42000E-08 | .15000E+02 | 1 |
| 9 | .70683E-02 | .11156E-01 | .42000E-08 | .15000E+02 | 1 | 10 | .66601E-02 | .10703E-01 | .42000E-08 | .15000E+02 | 1 |
| 11 | .63202E-02 | .10313E-01 | .42000E-08 | .15000E+02 | 1 | 12 | .60363E-02 | .99804E-02 | .42000E-08 | .15000E+02 | 1 |
| 13 | .57954E-02 | .96948E-02 | .42000E-08 | .15000E+02 | 1 | 14 | .55846E-02 | .94454E-02 | .42000E-08 | .15000E+02 | 1 |
| 15 | .53907E-02 | .92203E-02 | .42000E-08 | .15000E+02 | 1 | 16 | .52015E-02 | .90069E-02 | .42000E-08 | .15000E+02 | 1 |
| 17 | .50053E-02 | .87928E-02 | .42000E-08 | .15000E+02 | 1 | 18 | .47919E-02 | .85659E-02 | .42000E-08 | .15000E+02 | 1 |
| 19 | .45525E-02 | .83154E-02 | .42000E-08 | .15000E+02 | 1 | 20 | .42801E-02 | .80320E-02 | .42000E-08 | .15000E+02 | 1 |
| 21 | .39704E-02 | .77086E-02 | .42000E-08 | .15000E+02 | 1 | 22 | .36214E-02 | .73407E-02 | .42000E-08 | .15000E+02 | 1 |
| 23 | .32343E-02 | .69271E-02 | .42000E-08 | .15000E+02 | 1 | 24 | .28134E-02 | .64703E-02 | .42000E-08 | .15000E+02 | 1 |
| 25 | .23669E-02 | .59772E-02 | .42000E-08 | .15000E+02 | 1 | 26 | .19071E-02 | .54596E-02 | .42000E-08 | .15000E+02 | 1 |
| 27 | .14506E-02 | .49343E-02 | .42000E-08 | .15000E+02 | 1 | 28 | .10187E-02 | .44244E-02 | .42000E-08 | .15000E+02 | 1 |
| 29 | .63815E-03 | .39592E-02 | .42000E-08 | .15000E+02 | 1 | 30 | .34081E-03 | .35752E-02 | .42000E-08 | .15000E+02 | 1 |
| 31 | .16457E-03 | .33162E-02 | .42000E-08 | .15000E+02 | 1 | 32 | .15348E-03 | .32341E-02 | .42000E-08 | .15000E+02 | 1 |
| 33 | .35811E-03 | .33895E-02 | .42000E-08 | .15000E+02 | 1 | 34 | .83595E-03 | .38520E-02 | .42000E-08 | .15000E+02 | 1 |
| 35 | .16518E-02 | .47009E-02 | .42000E-08 | .15000E+02 | 1 | | | | | | |



92500

HYDRODYNAMIC GAS OR LIQUID BEARING PROGRAM

P = Pressure (psia)
U BAR = Tangential Fluid Velocity (in./sec.)
W BAR = Axial Fluid Velocity (in./sec.)
RE = Local Reynolds Number

SYMMETRY ROUTINE USED -- VALUES PRINTED ARE FOR WHOLE BEARING

| ECCENTRICITY RATIO (---) | RESULTANT FORCE (LBS) | ATTITUDE ANGLE (DEGREES) | JOURNAL FRIC. MOMENT (IN-LBS) | BEARING FRIC. MOMENT (IN-LBS) |
|---|---|---|---|---|
| .0040 | 167.61 | 22.38 | .284 | .081 |

| FRICTION (HP) | FRICTION (WATTS) | LUBRICANT FLOW 1 (CU.IN./SEC.) | LUBRICANT FLOW 2 (CU.IN./SEC.) | LUBRICANT FLOW 3 (CU.IN./SEC.) |
|---|---|---|---|---|
| .14981 | 110.97 | ********** | 1.479 | 4.520 |

| FX--FORCE COMPONENT (LBS) | FY--FORCE COMPONENT (LBS) | MX--MOMENT (IN-LBS) | MY--MOMENT (IN-LBS) |
|---|---|---|---|
| 154.42 | 65.17 | | |

I = 1

| J | P | U BAR | W BAR | RE | CODE | J | P | U BAR | W BAR | RE | CODE |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 15.00 | 262.87 | 0.00 | 1861. | 2. | 2 | 15.08 | 262.29 | -3.42 | 1775. | 2. |
| 3 | 15.16 | 283.51 | -6.64 | 1686. | 2. | 4 | 15.25 | 333.67 | -9.59 | 1598. | 2. |
| 5 | 15.35 | 385.34 | -12.39 | 1513. | 2. | 6 | 15.45 | 444.62 | -14.91 | 1434. | 2. |
| 7 | 15.56 | 514.20 | -17.38 | 1362. | 2. | 8 | 15.68 | 589.32 | -19.61 | 1296. | 2. |
| 9 | 15.81 | 673.26 | -21.90 | 1239. | 2. | 10 | 15.94 | 760.92 | -23.98 | 1189. | 2. |
| 11 | 16.07 | 856.08 | -25.20 | 1146. | 2. | 12 | 16.21 | 954.10 | -28.16 | 1109. | 2. |
| 13 | 16.35 | 1059.97 | -30.27 | 1077. | 2. | 14 | 16.50 | 1169.49 | -32.02 | 1049. | 2. |
| 15 | 16.65 | 1288.55 | -33.84 | 1025. | 2. | 16 | 16.79 | 1413.78 | -35.11 | 1001. | 2. |
| 17 | 16.93 | 1551.89 | -36.30 | 977. | 2. | 18 | 17.07 | 1697.57 | -36.72 | 952. | 2. |
| 19 | 17.21 | 1858.29 | -36.90 | 924. | 2. | 20 | 17.34 | 2030.64 | -36.11 | 893. | 2. |
| 21 | 17.47 | 2218.72 | -34.96 | 857. | 2. | 22 | 17.59 | 2421.20 | -32.42 | 816. | 2. |
| 23 | 17.71 | 2642.82 | -30.35 | 770. | 2. | 24 | 17.82 | 2886.19 | -27.07 | 720. | 2. |
| 25 | 17.92 | 3159.91 | -23.67 | 665. | 2. | 26 | 18.00 | 3473.16 | -19.87 | 608. | 2. |
| 27 | 18.04 | 3835.91 | -16.29 | 549. | 2. | 28 | 18.03 | 4267.35 | -12.80 | 493. | 2. |
| 29 | 17.92 | 4757.52 | -9.83 | 441. | 2. | 30 | 17.65 | 5279.27 | -7.27 | 398. | 2. |
| 31 | 17.16 | 5746.37 | -5.31 | 369. | 2. | 32 | 16.47 | 6015.99 | -3.72 | 360. | 2. |
| 33 | 15.75 | 5937.20 | -2.45 | 377. | 2. | 34 | 15.23 | 5451.45 | -1.27 | 429. | 2. |
| 35 | 15.00 | 4388.38 | 0.00 | 523. | 2. | | | | | | |

I = 2

| J | P | U BAR | W BAR | RE | CODE | J | P | U BAR | W BAR | RE | CODE |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 15.00 | 326.18 | 0.00 | 1861. | 2. | 2 | 15.09 | 328.87 | 16.16 | 1775. | 2. |
| 3 | 15.16 | 362.80 | 31.36 | 1686. | 2. | 4 | 15.24 | 405.55 | 45.48 | 1598. | 2. |
| 5 | 15.34 | 454.75 | 58.70 | 1513. | 2. | 6 | 15.44 | 521.04 | 71.06 | 1434. | 2. |
| 7 | 15.55 | 592.26 | 82.81 | 1362. | 2. | 8 | 15.67 | 668.26 | 94.00 | 1296. | 2. |
| 9 | 15.79 | 752.35 | 104.96 | 1239. | 2. | 10 | 15.92 | 839.07 | 115.45 | 1189. | 2. |
| 11 | 16.05 | 932.60 | 125.86 | 1146. | 2. | 12 | 16.19 | 1027.40 | 135.82 | 1109. | 2. |
| 13 | 16.33 | 1130.01 | 145.45 | 1077. | 2. | 14 | 16.47 | 1234.92 | 154.25 | 1049. | 2. |
| 15 | 16.61 | 1348.76 | 162.36 | 1025. | 2. | 16 | 16.76 | 1468.04 | 168.47 | 1001. | 2. |

| | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 17 | 16.80 | 1539.07 | 173.94 | 977. | 2. | 18 | 17.02 | 1738.95 | 175.11 | 952. | 2. |
| 19 | 17.16 | 1893.01 | 174.58 | 924. | 2. | 20 | 17.29 | 2058.71 | 170.84 | 893. | 2. |
| 21 | 17.41 | 2240.37 | 164.04 | 857. | 2. | 22 | 17.54 | 2436.70 | 153.95 | 816. | 2. |
| 23 | 17.65 | 2652.60 | 141.13 | 770. | 2. | 24 | 17.76 | 2890.67 | 125.85 | 720. | 2. |
| 25 | 17.85 | 3159.56 | 109.11 | 665. | 2. | 26 | 17.94 | 3468.38 | 91.61 | 608. | 2. |
| 27 | 17.99 | 3829.99 | 74.51 | 549. | 2. | 28 | 17.98 | 4254.39 | 58.58 | 493. | 2. |
| 29 | 17.87 | 4740.39 | 44.68 | 441. | 2. | 30 | 17.60 | 5257.71 | 33.15 | 398. | 2. |
| 31 | 17.12 | 5720.10 | 24.06 | 369. | 2. | 32 | 16.44 | 5985.38 | 16.95 | 360. | 2. |
| 33 | 15.73 | 5913.68 | 11.15 | 377. | 2. | 34 | 15.22 | 5417.84 | 5.80 | 429. | 2. |
| 35 | 15.00 | 4357.98 | 0.00 | 523. | 2. | | | | | | |

I = 3

| J | P | U BAR | W BAR | RE | CODE | J | P | U BAR | W BAR | RE | CODE |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 15.00 | 583.76 | 0.00 | 1861. | 2. | 2 | 15.07 | 600.21 | 50.58 | 1775. | 2. |
| 3 | 15.14 | 644.63 | 97.85 | 1686. | 2. | 4 | 15.23 | 697.80 | 141.68 | 1598. | 2. |
| 5 | 15.31 | 761.25 | 182.02 | 1513. | 2. | 6 | 15.40 | 830.73 | 219.54 | 1434. | 2. |
| 7 | 15.50 | 907.75 | 254.45 | 1362. | 2. | 8 | 15.61 | 987.36 | 287.76 | 1296. | 2. |
| 9 | 15.72 | 1071.54 | 319.51 | 1239. | 2. | 10 | 15.83 | 1155.25 | 350.61 | 1189. | 2. |
| 11 | 15.95 | 1241.62 | 380.68 | 1146. | 2. | 12 | 16.08 | 1326.32 | 410.28 | 1109. | 2. |
| 13 | 16.20 | 1413.94 | 438.35 | 1077. | 2. | 14 | 16.33 | 1501.35 | 465.04 | 1049. | 2. |
| 15 | 16.45 | 1594.34 | 488.52 | 1025. | 2. | 16 | 16.58 | 1690.84 | 508.55 | 1001. | 2. |
| 17 | 16.71 | 1796.89 | 522.76 | 977. | 2. | 18 | 16.83 | 1910.91 | 530.81 | 952. | 2. |
| 19 | 16.95 | 2038.23 | 539.26 | 924. | 2. | 20 | 17.08 | 2177.44 | 521.23 | 893. | 2. |
| 21 | 17.20 | 2332.90 | 501.93 | 857. | 2. | 22 | 17.32 | 2504.23 | 473.51 | 816. | 2. |
| 23 | 17.43 | 2696.34 | 435.57 | 770. | 2. | 24 | 17.54 | 2912.46 | 390.62 | 720. | 2. |
| 25 | 17.63 | 3160.92 | 339.89 | 665. | 2. | 26 | 17.71 | 3451.03 | 286.98 | 608. | 2. |
| 27 | 17.76 | 3700.98 | 234.17 | 549. | 2. | 28 | 17.76 | 4202.12 | 185.02 | 493. | 2. |
| 29 | 17.66 | 4670.49 | 141.42 | 441. | 2. | 30 | 17.42 | 5168.94 | 105.21 | 398. | 2. |
| 31 | 16.97 | 5611.74 | 76.27 | 369. | 2. | 32 | 16.33 | 5858.77 | 53.65 | 360. | 2. |
| 33 | 15.66 | 5765.35 | 35.07 | 377. | 2. | 34 | 15.19 | 5279.11 | 18.16 | 429. | 2. |
| 35 | 15.00 | 4233.32 | 0.00 | 523. | 2. | | | | | | |

I = 4

| J | P | U BAR | W BAR | RE | CODE | J | P | U BAR | W BAR | RE | CODE |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 15.00 | 1333.41 | 0.00 | 1861. | 2. | 2 | 15.05 | 1383.89 | 163.10 | 1775. | 2. |
| 3 | 15.11 | 1454.31 | 308.03 | 1686. | 2. | 4 | 15.17 | 1528.60 | 434.79 | 1598. | 2. |
| 5 | 15.23 | 1610.37 | 545.16 | 1513. | 2. | 6 | 15.30 | 1692.46 | 640.90 | 1434. | 2. |
| 7 | 15.37 | 1774.29 | 725.41 | 1362. | 2. | 8 | 15.45 | 1859.36 | 800.89 | 1296. | 2. |
| 9 | 15.52 | 1939.83 | 870.70 | 1239. | 2. | 10 | 15.60 | 2010.96 | 936.32 | 1189. | 2. |
| 11 | 15.69 | 2078.68 | 1000.36 | 1146. | 2. | 12 | 15.77 | 2135.21 | 1062.77 | 1109. | 2. |
| 13 | 15.86 | 2188.72 | 1124.89 | 1077. | 2. | 14 | 15.95 | 2233.08 | 1184.72 | 1049. | 2. |
| 15 | 16.04 | 2278.10 | 1242.10 | 1025. | 2. | 16 | 16.13 | 2319.17 | 1293.06 | 1001. | 2. |
| 17 | 16.22 | 2366.45 | 1336.14 | 977. | 2. | 18 | 16.31 | 2416.30 | 1365.99 | 952. | 2. |
| 19 | 16.41 | 2477.84 | 1380.79 | 924. | 2. | 20 | 16.50 | 2548.23 | 1374.88 | 893. | 2. |
| 21 | 16.60 | 2635.13 | 1347.61 | 857. | 2. | 22 | 16.69 | 2737.35 | 1295.32 | 816. | 2. |
| 23 | 16.79 | 2862.30 | 1219.72 | 770. | 2. | 24 | 16.88 | 3012.97 | 1120.76 | 720. | 2. |
| 25 | 16.97 | 3198.91 | 1003.63 | 665. | 2. | 26 | 17.05 | 3428.75 | 872.25 | 608. | 2. |
| 27 | 17.11 | 3714.36 | 734.54 | 549. | 2. | 28 | 17.12 | 4063.81 | 596.70 | 493. | 2. |
| 29 | 17.06 | 4472.99 | 466.48 | 441. | 2. | 30 | 16.87 | 4910.29 | 348.44 | 398. | 2. |
| 31 | 16.51 | 5290.81 | 245.87 | 369. | 2. | 32 | 15.99 | 5483.87 | 158.53 | 360. | 2. |
| 33 | 15.46 | 5357.78 | 86.53 | 377. | 2. | 34 | 15.11 | 4875.76 | 31.84 | 429. | 2. |
| 35 | 15.00 | 3876.48 | 0.00 | 523. | 2. | | | | | | |

I = 5

| J | P | U BAR | W BAR | RE | CODE | J | P | U BAR | W BAR | RE | CODE |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 15.00 | 3917.16 | 0.00 | 1861. | 2. | 2 | 15.00 | 3921.26 | 338.88 | 1775. | 2. |
| 3 | 15.00 | 3923.19 | 633.35 | 1686. | 2. | 4 | 15.00 | 3924.91 | 883.70 | 1598. | 2. |
| 5 | 15.00 | 3926.65 | 1095.71 | 1513. | 2. | 6 | 15.00 | 3927.80 | 1272.65 | 1434. | 2. |
| 7 | 15.00 | 3928.97 | 1424.17 | 1362. | 2. | 8 | 15.00 | 3929.97 | 1553.24 | 1296. | 2. |
| 9 | 15.00 | 3930.81 | 1679.66 | 1239. | 2. | 10 | 15.00 | 3931.51 | 1776.84 | 1189. | 2. |
| 11 | 15.00 | 3932.10 | 1882.09 | 1146. | 2. | 12 | 15.00 | 3932.59 | 1942.81 | 1109. | 2. |
| 13 | 15.00 | 3933.01 | 2057.87 | 1077. | 2. | 14 | 15.00 | 3933.37 | 2183.79 | 1049. | 2. |
| 15 | 15.00 | 3933.71 | 2242.82 | 1025. | 2. | 16 | 15.00 | 3934.03 | 2385.49 | 1001. | 2. |
| 17 | 15.00 | 3934.37 | 2472.81 | 977. | 2. | 18 | 15.00 | 3934.74 | 2536.79 | 952. | 2. |
| 19 | 15.00 | 3935.14 | 2561.71 | 924. | 2. | 20 | 15.00 | 3935.63 | 2584.34 | 893. | 2. |
| 21 | 15.00 | 3936.19 | 2562.29 | 857. | 2. | 22 | 15.00 | 3936.76 | 2486.57 | 816. | 2. |
| 23 | 15.00 | 3937.63 | 2478.99 | 770. | 2. | 24 | 15.00 | 3938.15 | 2284.41 | 720. | 2. |
| 25 | 15.00 | 3939.24 | 2302.36 | 665. | 2. | 26 | 15.00 | 3939.74 | 1963.50 | 608. | 2. |
| 27 | 15.00 | 3940.52 | 1984.76 | 549. | 2. | 28 | 15.00 | 3941.26 | 1238.54 | 493. | 2. |



0 0 5 2 9

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 29 | 15.00 | 3941.02 | 977.65 | 441. | 2. | 30 | 15.00 | 3942.43 | 731.18 | 398. | 2. | |
| 31 | 15.00 | 3942.76 | 510.02 | 362. | 2. | 32 | 15.00 | 3942.76 | 315.56 | 360. | 2. | |
| 33 | 15.00 | 3942.40 | 155.22 | 377. | 2. | 34 | 15.00 | 3941.58 | 41.58 | 429. | 2. | |
| 35 | 15.00 | 3940.17 | 0.00 | 523. | 2. | | | | | | | |



62500

# FOIL 2

I = 1

| I | CLEARANCE | FILM THICK | VISCOSITY | PRESSURE | CODE | J | CLEARANCE | FILM THICK | VISCOSITY | PRESSURE | CODE |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | .12652E-01 | .15701E-01 | .42000E-08 | .15000E+02 | 1 | 2 | .11899E-01 | .14888E-01 | .42000E-08 | .15077E+02 | 0 |
| 3 | .11132E-01 | .14058E-01 | .42000E-08 | .15160E+02 | 0 | 4 | .10383E-01 | .13246E-01 | .42000E-08 | .15249E+02 | 0 |
| 5 | .96778E-02 | .12475E-01 | .42000E-08 | .15346E+02 | 0 | 6 | .90359E-02 | .11767E-01 | .42000E-08 | .15450E+02 | 0 |
| 7 | .84699E-02 | .11132E-01 | .42000E-08 | .15561E+02 | 0 | 8 | .79869E-02 | .10580E-01 | .42000E-08 | .15680E+02 | 0 |
| 9 | .75892E-02 | .10111E-01 | .42000E-08 | .15806E+02 | 0 | 10 | .72747E-02 | .97243E-02 | .42000E-08 | .15937E+02 | 0 |
| 11 | .70374E-02 | .94133E-02 | .42000E-08 | .16074E+02 | 0 | 12 | .68683E-02 | .91693E-02 | .42000E-08 | .16214E+02 | 0 |
| 13 | .67556E-02 | .89804E-02 | .42000E-08 | .16357E+02 | 0 | 14 | .66857E-02 | .88332E-02 | .42000E-08 | .16501E+02 | 0 |
| 15 | .66436E-02 | .87126E-02 | .42000E-08 | .16646E+02 | 0 | 16 | .66134E-02 | .86029E-02 | .42000E-08 | .16788E+02 | 0 |
| 17 | .65792E-02 | .84880E-02 | .42000E-08 | .16931E+02 | 0 | 18 | .65254E-02 | .83525E-02 | .42000E-08 | .17069E+02 | 0 |
| 19 | .64374E-02 | .81818E-02 | .42000E-08 | .17206E+02 | 0 | 20 | .63022E-02 | .79631E-02 | .42000E-08 | .17338E+02 | 0 |
| 21 | .61093E-02 | .76858E-02 | .42000E-08 | .17468E+02 | 0 | 22 | .58508E-02 | .73419E-02 | .42000E-08 | .17591E+02 | 0 |
| 23 | .55220E-02 | .69270E-02 | .42000E-08 | .17710E+02 | 0 | 24 | .51227E-02 | .64409E-02 | .42000E-08 | .17820E+02 | 0 |
| 25 | .46571E-02 | .58877E-02 | .42000E-08 | .17920E+02 | 0 | 26 | .41344E-02 | .52768E-02 | .42000E-08 | .17998E+02 | 0 |
| 27 | .35701E-02 | .46236E-02 | .42000E-08 | .18045E+02 | 0 | 28 | .29856E-02 | .39498E-02 | .42000E-08 | .18031E+02 | 0 |
| 29 | .24098E-02 | .32841E-02 | .42000E-08 | .17918E+02 | 0 | 30 | .18789E-02 | .26628E-02 | .42000E-08 | .17645E+02 | 0 |
| 31 | .14375E-02 | .21306E-02 | .42000E-08 | .17160E+02 | 0 | 32 | .11389E-02 | .17408E-02 | .42000E-08 | .16473E+02 | 0 |
| 33 | .10460E-02 | .15564E-02 | .42000E-08 | .15750E+02 | 0 | 34 | .12314E-02 | .16501E-02 | .42000E-08 | .15226E+02 | 0 |
| 35 | .17787E-02 | .21054E-02 | .42000E-08 | .15000E+02 | 1 | | | | | | |

I = 2

| J | CLEARANCE | FILM THICK | VISCOSITY | PRESSURE | CODE | J | CLEARANCE | FILM THICK | VISCOSITY | PRESSURE | CODE |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | .12652E-01 | .15701E-01 | .42000E-08 | .15000E+02 | 1 | 2 | .11899E-01 | .14888E-01 | .42000E-08 | .15075E+02 | 0 |
| 3 | .11132E-01 | .14058E-01 | .42000E-08 | .15157E+02 | 0 | 4 | .10383E-01 | .13246E-01 | .42000E-08 | .15244E+02 | 0 |
| 5 | .96778E-02 | .12475E-01 | .42000E-08 | .15339E+02 | 0 | 6 | .90359E-02 | .11767E-01 | .42000E-08 | .15441E+02 | 0 |
| 7 | .84699E-02 | .11132E-01 | .42000E-08 | .15550E+02 | 0 | 8 | .79869E-02 | .10580E-01 | .42000E-08 | .15666E+02 | 0 |
| 9 | .75892E-02 | .10111E-01 | .42000E-08 | .15789E+02 | 0 | 10 | .72747E-02 | .97243E-02 | .42000E-08 | .15917E+02 | 0 |
| 11 | .70374E-02 | .94133E-02 | .42000E-08 | .16050E+02 | 0 | 12 | .68683E-02 | .91693E-02 | .42000E-08 | .16187E+02 | 0 |
| 13 | .67556E-02 | .89804E-02 | .42000E-08 | .16327E+02 | 0 | 14 | .66857E-02 | .88332E-02 | .42000E-08 | .16467E+02 | 0 |
| 15 | .66436E-02 | .87126E-02 | .42000E-08 | .16608E+02 | 0 | 16 | .66134E-02 | .86029E-02 | .42000E-08 | .16748E+02 | 0 |
| 17 | .65792E-02 | .84880E-02 | .42000E-08 | .16887E+02 | 0 | 18 | .65254E-02 | .83525E-02 | .42000E-08 | .17023E+02 | 0 |
| 19 | .64374E-02 | .81818E-02 | .42000E-08 | .17157E+02 | 0 | 20 | .63022E-02 | .79631E-02 | .42000E-08 | .17287E+02 | 0 |
| 21 | .61093E-02 | .76858E-02 | .42000E-08 | .17415E+02 | 0 | 22 | .58508E-02 | .73419E-02 | .42000E-08 | .17537E+02 | 0 |
| 23 | .55220E-02 | .69270E-02 | .42000E-08 | .17655E+02 | 0 | 24 | .51227E-02 | .64409E-02 | .42000E-08 | .17764E+02 | 0 |
| 25 | .46571E-02 | .58877E-02 | .42000E-08 | .17864E+02 | 0 | 26 | .41344E-02 | .52768E-02 | .42000E-08 | .17942E+02 | 0 |
| 27 | .35701E-02 | .46236E-02 | .42000E-08 | .17990E+02 | 0 | 28 | .29856E-02 | .39498E-02 | .42000E-08 | .17978E+02 | 0 |
| 29 | .24098E-02 | .32841E-02 | .42000E-08 | .17869E+02 | 0 | 30 | .18789E-02 | .26628E-02 | .42000E-08 | .17600E+02 | 0 |
| 31 | .14375E-02 | .21306E-02 | .42000E-08 | .17122E+02 | 0 | 32 | .11389E-02 | .17408E-02 | .42000E-08 | .16445E+02 | 0 |
| 33 | .10460E-02 | .15564E-02 | .42000E-08 | .15733E+02 | 0 | 34 | .12314E-02 | .16501E-02 | .42000E-08 | .15220E+02 | 0 |
| 35 | .17787E-02 | .21054E-02 | .42000E-08 | .15000E+02 | 1 | | | | | | |

I = 3

| J | CLEARANCE | FILM THICK | VISCOSITY | PRESSURE | CODE | J | CLEARANCE | FILM THICK | VISCOSITY | PRESSURE | CODE |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | .12652E-01 | .15701E-01 | .42000E-08 | .15000E+02 | 1 | 2 | .11899E-01 | .14888E-01 | .42000E-08 | .15070E+02 | 0 |
| 3 | .11132E-01 | .14058E-01 | .42000E-08 | .15145E+02 | 0 | 4 | .10383E-01 | .13246E-01 | .42000E-08 | .15225E+02 | 0 |
| 5 | .96778E-02 | .12475E-01 | .42000E-08 | .15312E+02 | 0 | 6 | .90359E-02 | .11767E-01 | .42000E-08 | .15405E+02 | 0 |
| 7 | .84699E-02 | .11132E-01 | .42000E-08 | .15504E+02 | 0 | 8 | .79869E-02 | .10580E-01 | .42000E-08 | .15609E+02 | 0 |
| 9 | .75892E-02 | .10111E-01 | .42000E-08 | .15719E+02 | 0 | 10 | .72747E-02 | .97243E-02 | .42000E-08 | .15834E+02 | 0 |
| 11 | .70374E-02 | .94133E-02 | .42000E-08 | .15954E+02 | 0 | 12 | .68683E-02 | .91693E-02 | .42000E-08 | .16077E+02 | 0 |
| 13 | .67556E-02 | .89804E-02 | .42000E-08 | .16202E+02 | 0 | 14 | .66857E-02 | .88332E-02 | .42000E-08 | .16328E+02 | 0 |
| 15 | .66436E-02 | .87126E-02 | .42000E-08 | .16456E+02 | 0 | 16 | .66134E-02 | .86029E-02 | .42000E-08 | .16582E+02 | 0 |
| 17 | .65792E-02 | .84880E-02 | .42000E-08 | .16703E+02 | 0 | 18 | .65254E-02 | .83525E-02 | .42000E-08 | .16834E+02 | 0 |
| 19 | .64374E-02 | .81818E-02 | .42000E-08 | .16938E+02 | 0 | 20 | .63022E-02 | .79631E-02 | .42000E-08 | .17080E+02 | 0 |
| 21 | .61093E-02 | .76858E-02 | .42000E-08 | .17155E+02 | 0 | 22 | .58508E-02 | .73419E-02 | .42000E-08 | .17316E+02 | 0 |
| 23 | .55220E-02 | .69270E-02 | .42000E-08 | .17342E+02 | 0 | 24 | .51227E-02 | .64409E-02 | .42000E-08 | .17535E+02 | 0 |
| 25 | .46571E-02 | .58877E-02 | .42000E-08 | .17484E+02 | 0 | 26 | .41344E-02 | .52768E-02 | .42000E-08 | .17713E+02 | 0 |

| | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| 27 | .35701E-02 | .46236E-02 | .42000E-08 | .17764E+02 | 0 | 28 | .29856E-02 | .39498E-02 | .42000E-08 | .17760E+02 | 0 |
| 29 | .24099E-02 | .32841E-02 | .42000E-08 | .17663E+02 | 0 | 30 | .18789E-02 | .26628E-02 | .42000E-08 | .17415E+02 | 0 |
| 31 | .14375E-02 | .21306E-02 | .42000E-08 | .16967E+02 | 0 | 32 | .11389E-02 | .17408E-02 | .42000E-08 | .16330E+02 | 0 |
| 33 | .10460E-02 | .15564E-02 | .42000E-08 | .15664E+02 | 0 | 34 | .12314E-02 | .16501E-02 | .42000E-08 | .15192E+02 | 0 |
| 35 | .17787E-02 | .21054E-02 | .42000E-08 | .15000E+02 | 1 | | | | | | |

I = 4

| J | CLEARANCE | FILM THICK | VISCOSITY | PRESSURE | CODE | J | CLEARANCE | FILM THICK | VISCOSITY | PRESSURE | CODE |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | .12652E-01 | .15701E-01 | .42000E-08 | .15000E+02 | 1 | 2 | .11899E-01 | .14888E-01 | .42000E-08 | .15054E+02 | 0 |
| 3 | .11132E-01 | .14058E-01 | .42000E-08 | .15111E+02 | 0 | 4 | .10383E-01 | .13246E-01 | .42000E-08 | .15171E+02 | 0 |
| 5 | .96778E-02 | .12475E-01 | .42000E-08 | .15235E+02 | 0 | 6 | .90359E-02 | .11767E-01 | .42000E-08 | .15302E+02 | 0 |
| 7 | .84600E-02 | .11132E-01 | .42000E-08 | .15373E+02 | 0 | 8 | .79869E-02 | .10580E-01 | .42000E-08 | .15447E+02 | 0 |
| 9 | .75892E-02 | .10111E-01 | .42000E-08 | .15525E+02 | 0 | 10 | .72747E-02 | .97243E-02 | .42000E-08 | .15604E+02 | 0 |
| 11 | .70374E-02 | .94133E-02 | .42000E-08 | .15687E+02 | 0 | 12 | .68683E-02 | .91693E-02 | .42000E-08 | .15771E+02 | 0 |
| 13 | .67556E-02 | .89804E-02 | .42000E-08 | .15858E+02 | 0 | 14 | .66857E-02 | .88332E-02 | .42000E-08 | .15945E+02 | 0 |
| 15 | .66436E-02 | .87126E-02 | .42000E-08 | .16036E+02 | 0 | 16 | .66134E-02 | .86029E-02 | .42000E-08 | .16125E+02 | 0 |
| 17 | .65702E-02 | .84883E-02 | .42000E-08 | .16218E+02 | 0 | 18 | .65254E-02 | .83525E-02 | .42000E-08 | .16310E+02 | 0 |
| 19 | .64374E-02 | .81818E-02 | .42000E-08 | .16405E+02 | 0 | 20 | .63022E-02 | .79631E-02 | .42000E-08 | .16499E+02 | 0 |
| 21 | .61093E-02 | .76858E-02 | .42000E-08 | .16596E+02 | 0 | 22 | .58508E-02 | .73419E-02 | .42000E-08 | .16690E+02 | 0 |
| 23 | .55220E-02 | .69270E-02 | .42000E-08 | .16788E+02 | 0 | 24 | .51227E-02 | .64409E-02 | .42000E-08 | .16881E+02 | 0 |
| 25 | .46571E-02 | .58877E-02 | .42000E-08 | .16972E+02 | 0 | 26 | .41344E-02 | .52768E-02 | .42000E-08 | .17050E+02 | 0 |
| 27 | .35701E-02 | .46236E-02 | .42000E-08 | .17103E+02 | 0 | 28 | .29856E-02 | .39498E-02 | .42000E-08 | .17122E+02 | 0 |
| 29 | .24099E-02 | .32841E-02 | .42000E-08 | .17061E+02 | 0 | 30 | .18789E-02 | .26628E-02 | .42000E-08 | .16871E+02 | 0 |
| 31 | .14375E-02 | .21306E-02 | .42000E-08 | .16512E+02 | 0 | 32 | .11389E-02 | .17408E-02 | .42000E-08 | .15995E+02 | 0 |
| 33 | .10460E-02 | .15564E-02 | .42000E-08 | .15464E+02 | 0 | 34 | .12314E-02 | .16501E-02 | .42000E-08 | .15110E+02 | 0 |
| 35 | .17787E-02 | .21054E-02 | .42000E-08 | .15000E+02 | 1 | | | | | | |

I = 5

| J | CLEARANCE | FILM THICK | VISCOSITY | PRESSURE | CODE | J | CLEARANCE | FILM THICK | VISCOSITY | PRESSURE | CODE |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | .12652E-01 | .15701E-01 | .42000E-08 | .15000E+02 | 1 | 2 | .11899E-01 | .14888E-01 | .42000E-08 | .15000E+02 | 1 |
| 3 | .11132E-01 | .14058E-01 | .42000E-08 | .15000E+02 | 1 | 4 | .10383E-01 | .13246E-01 | .42000E-08 | .15000E+02 | 1 |
| 5 | .96778E-02 | .12475E-01 | .42000E-08 | .15000E+02 | 1 | 6 | .90359E-02 | .11767E-01 | .42000E-08 | .15000E+02 | 1 |
| 7 | .84600E-02 | .11132E-01 | .42000E-08 | .15000E+02 | 1 | 8 | .79869E-02 | .10580E-01 | .42000E-08 | .15000E+02 | 1 |
| 9 | .75892E-02 | .10111E-01 | .42000E-08 | .15000E+02 | 1 | 10 | .72747E-02 | .97243E-02 | .42000E-08 | .15000E+02 | 1 |
| 11 | .70374E-02 | .94133E-02 | .42000E-08 | .15000E+02 | 1 | 12 | .68683E-02 | .91693E-02 | .42000E-08 | .15000E+02 | 1 |
| 13 | .67556E-02 | .89804E-02 | .42000E-08 | .15000E+02 | 1 | 14 | .66857E-02 | .88332E-02 | .42000E-08 | .15000E+02 | 1 |
| 15 | .66436E-02 | .87126E-02 | .42000E-08 | .15000E+02 | 1 | 16 | .66134E-02 | .86029E-02 | .42000E-08 | .15000E+02 | 1 |
| 17 | .65702E-02 | .84883E-02 | .42000E-08 | .15000E+02 | 1 | 18 | .65254E-02 | .83525E-02 | .42000E-08 | .15000E+02 | 1 |
| 19 | .64374E-02 | .81818E-02 | .42000E-08 | .15000E+02 | 1 | 20 | .63022E-02 | .79631E-02 | .42000E-08 | .15000E+02 | 1 |
| 21 | .61093E-02 | .76858E-02 | .42000E-08 | .15000E+02 | 1 | 22 | .58508E-02 | .73419E-02 | .42000E-08 | .15000E+02 | 1 |
| 23 | .55220E-02 | .69270E-02 | .42000E-08 | .15000E+02 | 1 | 24 | .51227E-02 | .64409E-02 | .42000E-08 | .15000E+02 | 1 |
| 25 | .46571E-02 | .58877E-02 | .42000E-08 | .15000E+02 | 1 | 26 | .41344E-02 | .52768E-02 | .42000E-08 | .15000E+02 | 1 |
| 27 | .35701E-02 | .46236E-02 | .42000E-08 | .15000E+02 | 1 | 28 | .29856E-02 | .39498E-02 | .42000E-08 | .15000E+02 | 1 |
| 29 | .24099E-02 | .32841E-02 | .42000E-08 | .15000E+02 | 1 | 30 | .18789E-02 | .26628E-02 | .42000E-08 | .15000E+02 | 1 |
| 31 | .14375E-02 | .21306E-02 | .42000E-08 | .15000E+02 | 1 | 32 | .11389E-02 | .17408E-02 | .42000E-08 | .15000E+02 | 1 |
| 33 | .10460E-02 | .15564E-02 | .42000E-08 | .15000E+02 | 1 | 34 | .12314E-02 | .16501E-02 | .42000E-08 | .15000E+02 | 1 |
| 35 | .17787E-02 | .21054E-02 | .42000E-08 | .15000E+02 | 1 | | | | | | |



C C C 0 S

HYDRODYNAMIC GAS OR LIQUID BEARING PROGRAM

ITERATION FOR VSTAR AT LIMIT FRICTION CALCULATIONS DELETED

SYMMETRY ROUTINE USED -- VALUES PRINTED ARE FOR WHOLE BEARING

| ECCENTRICITY RATIO (---) | RESULTANT FORCE (LBS) | ATTITUDE ANGLE (DEGREES) | JOURNAL FRIC. MOMENT (IN-LBS) | BEARING FRIC. MOMENT (IN-LBS) |
|---|---|---|---|---|
| .0040 | 170.89 | 23.23 | .352 | .062 |
| **FRICTION (HP)** | **FRICTION (WATTS)** | **LUBRICANT FLOW 1 (CU.IN./SEC.)** | **LUBRICANT FLOW 2 (CU.IN./SEC.)** | **LUBRICANT FLOW 3 (CU.IN./SEC.)** |
| .1840? | 137.25 | 4.520 | 1.240 | 3.762 |
| **FX--FORCE COMPONENT (LBS)** | **FY--FORCE COMPONENT (LBS)** | **MX--MOMENT (IN-LBS)** | **MY--MOMENT (IN-LBS)** | |
| 157.04 | 67.41 | | | |

I = 1

| J | P | U BAR | W BAR | RE | CODE | J | P | U BAR | W BAR | RE | CODE |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 15.00 | 735.47 | 0.00 | 1739. | 2. | 2 | 15.07 | 757.16 | -2.80 | 1650. | 2. |
| 3 | 15.15 | 807.87 | -5.46 | 1558. | 2. | 4 | 15.24 | 865.82 | -7.81 | 1469. | 2. |
| 5 | 15.33 | 931.56 | -10.07 | 1384. | 2. | 6 | 15.43 | 1001.36 | -12.07 | 1305. | 2. |
| 7 | 15.54 | 1075.57 | -14.08 | 1235. | 2. | 8 | 15.66 | 1149.98 | -15.89 | 1174. | 2. |
| 9 | 15.78 | 1225.24 | -17.84 | 1122. | 2. | 10 | 15.91 | 1297.39 | -19.64 | 1080. | 2. |
| 11 | 16.04 | 1368.09 | -21.68 | 1045. | 2. | 12 | 16.17 | 1434.40 | -23.56 | 1018. | 2. |
| 13 | 16.31 | 1499.21 | -25.78 | 997. | 2. | 14 | 16.45 | 1560.57 | -27.57 | 981. | 2. |
| 15 | 16.59 | 1621.81 | -29.63 | 968. | 2. | 16 | 16.72 | 1681.11 | -31.22 | 955. | 2. |
| 17 | 16.86 | 1740.89 | -32.82 | 943. | 2. | 18 | 16.99 | 1798.64 | -33.68 | 928. | 2. |
| 19 | 17.13 | 1855.86 | -34.31 | 909. | 2. | 20 | 17.27 | 1907.32 | -33.95 | 884. | 2. |
| 21 | 17.41 | 1955.30 | -33.19 | 864. | 2. | 22 | 17.56 | 1998.25 | -31.33 | 816. | 2. |
| 23 | 17.72 | 2038.37 | -29.83 | 770. | 2. | 24 | 17.89 | 2081.21 | -25.78 | 716. | 2. |
| 25 | 18.09 | 2136.15 | -22.29 | 656. | 2. | 26 | 18.31 | 2219.80 | -18.29 | 587. | 2. |
| 27 | 18.57 | 2353.83 | -14.64 | 514. | 2. | 28 | 18.87 | 2569.97 | -10.68 | 439. | 2. |
| 29 | 19.22 | 2954.47 | -7.49 | 365. | 2. | 30 | 19.52 | 3333.34 | -5.56 | 296. | 1. |
| 31 | 19.66 | 4080.13 | -3.41 | 237. | 1. | 32 | 19.36 | 4864.25 | -2.01 | 194. | 1. |
| 33 | 18.97 | 5452.29 | -1.18 | 173. | 1. | 34 | 16.09 | 5535.81 | -.60 | 184. | 1. |
| 35 | 15.00 | 5042.16 | 0.00 | 234. | 1. | | | | | | |

I = 2

| J | P | U BAR | W BAR | RE | CODE | J | P | U BAR | W BAR | RE | CODE |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 15.00 | 784.96 | 0.00 | 1739. | 2. | 2 | 15.07 | 814.71 | 13.56 | 1650. | 2. |
| 3 | 15.15 | 867.82 | 24.18 | 1558. | 2. | 4 | 15.24 | 927.93 | 37.82 | 1469. | 2. |
| 5 | 15.33 | 985.66 | 48.59 | 1384. | 2. | 6 | 15.43 | 1047.03 | 58.60 | 1305. | 2. |
| 7 | 15.53 | 1142.47 | 68.15 | 1235. | 2. | 8 | 15.65 | 1217.45 | 77.38 | 1174. | 2. |
| 9 | 15.76 | 1292.75 | 84.66 | 1122. | 2. | 10 | 15.89 | 1364.11 | 95.44 | 1080. | 2. |
| 11 | 16.02 | 1433.36 | 105.36 | 1045. | 2. | 12 | 16.15 | 1497.35 | 114.97 | 1018. | 2. |
| 13 | 16.28 | 1559.20 | 124.76 | 997. | 2. | 14 | 16.42 | 1616.83 | 134.29 | 981. | 2. |
| 15 | 16.55 | 1673.85 | 143.63 | 968. | 2. | 16 | 16.68 | 1728.38 | 151.45 | 955. | 2. |



0052

| | | | | | |
|---|---|---|---|---|---|
| 17 | 16.42 | 1743.11 | 158.09 | 943. | 2. |
| 19 | 17.08 | 1825.63 | 164.26 | 909. | 2. |
| 21 | 17.36 | 1976.47 | 157.76 | 854. | 2. |
| 23 | 17.66 | 2050.43 | 136.91 | 770. | 2. |
| 25 | 18.03 | 2141.15 | 104.31 | 654. | 2. |
| 27 | 18.52 | 2353.43 | 67.06 | 514. | 2. |
| 29 | 19.16 | 2951.30 | 34.55 | 365. | 2. |
| 31 | 19.61 | 4072.74 | 15.64 | 237. | 1. |
| 33 | 18.04 | 5438.40 | 5.41 | 173. | 1. |
| 35 | 15.00 | 5019.27 | 0.00 | 234. | 1. |

| | | | | | |
|---|---|---|---|---|---|
| 18 | 16.95 | 1835.54 | 162.45 | 928. | 2. |
| 20 | 17.22 | 1933.56 | 162.70 | 884. | 2. |
| 22 | 17.51 | 2014.63 | 149.01 | 816. | 2. |
| 24 | 17.84 | 2089.45 | 121.67 | 716. | 2. |
| 26 | 18.25 | 2222.10 | 85.64 | 587. | 2. |
| 28 | 18.82 | 2568.23 | 49.63 | 439. | 2. |
| 30 | 19.47 | 3327.82 | 25.67 | 296. | 1. |
| 32 | 19.32 | 4853.89 | 9.23 | 194. | 1. |
| 34 | 16.08 | 5518.66 | 2.76 | 184. | 1. |

I = 3

| J | P | U BAR | W BAR | RE | CODE |
|---|---|---|---|---|---|
| 1 | 15.00 | 1009.98 | 0.00 | 1739. | 2. |
| 3 | 15.14 | 1110.07 | 80.51 | 1558. | 2. |
| 5 | 15.30 | 1254.24 | 148.51 | 1384. | 2. |
| 7 | 15.49 | 1411.86 | 206.75 | 1235. | 2. |
| 9 | 15.70 | 1564.48 | 260.86 | 1122. | 2. |
| 11 | 15.92 | 1696.43 | 315.74 | 1045. | 2. |
| 13 | 16.16 | 1801.79 | 373.06 | 997. | 2. |
| 15 | 16.40 | 1885.48 | 429.21 | 968. | 2. |
| 17 | 16.64 | 1956.29 | 474.78 | 943. | 2. |
| 19 | 16.89 | 2017.65 | 496.30 | 909. | 2. |
| 21 | 17.15 | 2065.83 | 480.65 | 854. | 2. |
| 23 | 17.45 | 2102.72 | 421.54 | 770. | 2. |
| 25 | 17.81 | 2164.07 | 325.27 | 654. | 2. |
| 27 | 18.29 | 2355.99 | 212.36 | 514. | 2. |
| 29 | 18.94 | 2939.08 | 111.29 | 365. | 2. |
| 31 | 19.40 | 4042.55 | 51.13 | 237. | 1. |
| 33 | 17.90 | 5381.25 | 17.83 | 173. | 1. |
| 35 | 15.00 | 4925.54 | 0.00 | 234. | 1. |

| J | P | U BAR | W BAR | RE | CODE |
|---|---|---|---|---|---|
| 2 | 15.07 | 1047.65 | 41.78 | 1650. | 2. |
| 4 | 15.22 | 1179.03 | 116.05 | 1469. | 2. |
| 6 | 15.39 | 1332.07 | 178.59 | 1305. | 2. |
| 8 | 15.59 | 1489.46 | 234.04 | 1174. | 2. |
| 10 | 15.81 | 1633.19 | 288.10 | 1080. | 2. |
| 12 | 16.04 | 1751.82 | 344.33 | 1018. | 2. |
| 14 | 16.28 | 1845.28 | 401.92 | 981. | 2. |
| 16 | 16.52 | 1921.66 | 454.31 | 955. | 2. |
| 18 | 16.77 | 1987.98 | 489.68 | 928. | 2. |
| 20 | 17.03 | 2043.52 | 494.00 | 884. | 2. |
| 22 | 17.29 | 2084.70 | 456.71 | 816. | 2. |
| 24 | 17.61 | 2125.99 | 377.26 | 716. | 2. |
| 26 | 18.03 | 2233.61 | 269.28 | 587. | 2. |
| 28 | 18.59 | 2562.31 | 158.62 | 439. | 2. |
| 30 | 19.25 | 3305.68 | 83.47 | 296. | 1. |
| 32 | 19.13 | 4811.31 | 30.39 | 194. | 1. |
| 34 | 16.02 | 5448.03 | 9.08 | 184. | 1. |

I = 4

| J | P | U BAR | W BAR | RE | CODE |
|---|---|---|---|---|---|
| 1 | 15.00 | 1638.36 | 0.00 | 1739. | 2. |
| 3 | 15.11 | 1733.65 | 259.14 | 1558. | 2. |
| 5 | 15.23 | 1971.48 | 449.82 | 1384. | 2. |
| 7 | 15.36 | 2146.92 | 599.52 | 1235. | 2. |
| 9 | 15.51 | 2298.32 | 706.75 | 1122. | 2. |
| 11 | 15.66 | 2405.99 | 826.98 | 1045. | 2. |
| 13 | 15.82 | 2462.33 | 946.08 | 997. | 2. |
| 15 | 15.99 | 2474.41 | 1031.11 | 968. | 2. |
| 17 | 16.17 | 2456.10 | 1084.17 | 943. | 2. |
| 19 | 16.36 | 2417.59 | 1099.71 | 909. | 2. |
| 21 | 16.57 | 2363.95 | 1316.85 | 854. | 2. |
| 23 | 16.83 | 2304.08 | 1233.02 | 770. | 2. |
| 25 | 17.16 | 2280.59 | 1043.83 | 654. | 2. |
| 27 | 17.61 | 2461.76 | 774.85 | 514. | 2. |
| 29 | 18.26 | 2925.32 | 484.14 | 365. | 2. |
| 31 | 18.76 | 3958.36 | 264.47 | 237. | 1. |
| 33 | 17.68 | 5204.69 | 92.92 | 173. | 1. |
| 35 | 15.00 | 4636.93 | 0.00 | 234. | 1. |

| J | P | U BAR | W BAR | RE | CODE |
|---|---|---|---|---|---|
| 2 | 15.05 | 1707.82 | 138.61 | 1650. | 2. |
| 4 | 15.17 | 1880.78 | 362.15 | 1469. | 2. |
| 6 | 15.29 | 2059.76 | 524.78 | 1305. | 2. |
| 8 | 15.43 | 2225.93 | 650.03 | 1174. | 2. |
| 10 | 15.58 | 2357.29 | 762.90 | 1080. | 2. |
| 12 | 15.74 | 2439.24 | 881.71 | 1018. | 2. |
| 14 | 15.91 | 2471.92 | 1012.84 | 981. | 2. |
| 16 | 16.08 | 2467.26 | 1147.44 | 955. | 2. |
| 18 | 16.26 | 2438.45 | 1261.14 | 928. | 2. |
| 20 | 16.46 | 2392.19 | 1319.31 | 884. | 2. |
| 22 | 16.69 | 2333.02 | 1288.33 | 816. | 2. |
| 24 | 16.98 | 2283.01 | 1150.38 | 716. | 2. |
| 26 | 17.36 | 2313.00 | 915.93 | 587. | 2. |
| 28 | 17.91 | 2576.86 | 627.88 | 439. | 2. |
| 30 | 18.58 | 3255.84 | 398.47 | 296. | 1. |
| 32 | 18.56 | 4683.30 | 165.59 | 194. | 1. |
| 34 | 15.93 | 5229.41 | 36.60 | 184. | 1. |

I = 5

| J | P | U BAR | W BAR | RE | CODE |
|---|---|---|---|---|---|
| 1 | 15.00 | 3021.16 | 0.00 | 1739. | 2. |
| 3 | 15.00 | 3023.79 | 539.37 | 1558. | 2. |
| 5 | 15.00 | 3026.30 | 911.27 | 1384. | 2. |
| 7 | 15.00 | 3028.30 | 1163.12 | 1235. | 2. |
| 9 | 15.00 | 3029.91 | 1354.65 | 1122. | 2. |
| 11 | 15.00 | 3030.84 | 1547.73 | 1045. | 2. |
| 13 | 15.00 | 3031.35 | 1745.00 | 997. | 2. |
| 15 | 15.00 | 3031.59 | 1886.62 | 968. | 2. |
| 17 | 15.00 | 3031.65 | 2035.05 | 943. | 2. |
| 19 | 15.00 | 3031.83 | 2441.00 | 909. | 2. |
| 21 | 15.00 | 3032.67 | 2544.42 | 854. | 2. |
| 23 | 15.00 | 3033.68 | 2482.69 | 770. | 2. |
| 25 | 15.00 | 3034.98 | 2154.30 | 654. | 2. |
| 27 | 15.00 | 3036.25 | 1608.27 | 514. | 2. |

| J | P | U BAR | W BAR | RE | CODE |
|---|---|---|---|---|---|
| 2 | 15.00 | 3022.46 | 292.19 | 1650. | 2. |
| 4 | 15.00 | 3025.08 | 743.50 | 1469. | 2. |
| 6 | 15.00 | 3027.41 | 1047.87 | 1305. | 2. |
| 8 | 15.00 | 3029.22 | 1261.98 | 1174. | 2. |
| 10 | 15.00 | 3030.65 | 1443.48 | 1080. | 2. |
| 12 | 15.00 | 3031.15 | 1636.27 | 1018. | 2. |
| 14 | 15.00 | 3031.47 | 1861.31 | 981. | 2. |
| 16 | 15.00 | 3031.59 | 2110.88 | 955. | 2. |
| 18 | 15.00 | 3031.75 | 2345.72 | 928. | 2. |
| 20 | 15.00 | 3032.13 | 2504.00 | 884. | 2. |
| 22 | 15.00 | 3032.91 | 2516.52 | 816. | 2. |
| 24 | 15.00 | 3034.17 | 2332.85 | 716. | 2. |
| 26 | 15.00 | 3035.98 | 1945.37 | 587. | 2. |
| 28 | 15.00 | 3037.88 | 1408.76 | 439. | 2. |

| | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 29 | 15.00 | 3938.86 | 1118.45 | 365. | 2. | 30 | 15.00 | 3939.78 | 944.09 | 296. | 1. |
| 31 | 15.00 | 3940.58 | 639.22 | 237. | 1. | 32 | 15.00 | 3941.05 | 484.93 | 194. | 1. |
| 33 | 15.00 | 3941.21 | 224.45 | 173. | 1. | 34 | 15.00 | 3940.49 | 82.17 | 184. | 1. |
| 35 | 15.00 | 3939.95 | 0.00 | 234. | 1. | | | | | | |



00529

# FOIL 3

I = 1

| J | CLEARANCE | FILM THICK | VISCOSITY | PRESSURE | CODE | J | CLEARANCE | FILM THICK | VISCOSITY | PRESSURE | CODE |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | .12779E-01 | .13105E-01 | .42000E-08 | .15000E+02 | 1 | 2 | .11923E-01 | .12158E-01 | .42000E-08 | .15074E+02 | 0 |
| 3 | .11108E-01 | .11250E-01 | .42000E-08 | .15154E+02 | 0 | 4 | .10363E-01 | .10412E-01 | .42000E-08 | .15240E+02 | 0 |
| 5 | .97089E-02 | .96664E-02 | .42000E-08 | .15334E+02 | 0 | 6 | .91613E-02 | .90264E-02 | .42000E-08 | .15435E+02 | 0 |
| 7 | .87282E-02 | .85010E-02 | .42000E-08 | .15544E+02 | 0 | 8 | .84120E-02 | .80926E-02 | .42000E-08 | .15659E+02 | 0 |
| 9 | .82102E-02 | .77988E-02 | .42000E-08 | .15781E+02 | 0 | 10 | .81157E-02 | .76125E-02 | .42000E-08 | .15908E+02 | 0 |
| 11 | .81176E-02 | .75228E-02 | .42000E-08 | .16040E+02 | 0 | 12 | .82017E-02 | .75157E-02 | .42000E-08 | .16175E+02 | 0 |
| 13 | .83513E-02 | .75745E-02 | .42000E-08 | .16312E+02 | 0 | 14 | .85477E-02 | .76804E-02 | .42000E-08 | .16449E+02 | 0 |
| 15 | .87709E-02 | .78136E-02 | .42000E-08 | .16587E+02 | 0 | 16 | .90001E-02 | .79534E-02 | .42000E-08 | .16723E+02 | 0 |
| 17 | .92146E-02 | .80789E-02 | .42000E-08 | .16859E+02 | 0 | 18 | .93941E-02 | .81701E-02 | .42000E-08 | .16994E+02 | 0 |
| 19 | .95196E-02 | .82080E-02 | .42000E-08 | .17131E+02 | 0 | 20 | .95740E-02 | .81754E-02 | .42000E-08 | .17268E+02 | 0 |
| 21 | .95424E-02 | .80576E-02 | .42000E-08 | .17411E+02 | 0 | 22 | .94132E-02 | .78430E-02 | .42000E-08 | .17559E+02 | 0 |
| 23 | .91786E-02 | .75238E-02 | .42000E-08 | .17718E+02 | 0 | 24 | .88348E-02 | .70963E-02 | .42000E-08 | .17892E+02 | 0 |
| 25 | .83834E-02 | .65621E-02 | .42000E-08 | .18087E+02 | 0 | 26 | .78313E-02 | .59282E-02 | .42000E-08 | .18310E+02 | 0 |
| 27 | .71918E-02 | .52079E-02 | .42000E-08 | .18571E+02 | 0 | 28 | .64850E-02 | .44214E-02 | .42000E-08 | .18875E+02 | 0 |
| 29 | .57386E-02 | .35964E-02 | .42000E-08 | .19217E+02 | 0 | 30 | .49884E-02 | .27687E-02 | .42000E-08 | .19522E+02 | 0 |
| 31 | .42789E-02 | .19829E-02 | .42000E-08 | .19665E+02 | 0 | 32 | .36641E-02 | .12930E-02 | .42000E-08 | .19361E+02 | 0 |
| 33 | .32079E-02 | .76298E-03 | .42000E-08 | .18069E+02 | 0 | 34 | .29851E-02 | .46761E-03 | .42000E-08 | .16093E+02 | 0 |
| 35 | .30814E-02 | .49283E-03 | .42000E-08 | .15000E+02 | 1 | | | | | | |

I = 2

| J | CLEARANCE | FILM THICK | VISCOSITY | PRESSURE | CODE | J | CLEARANCE | FILM THICK | VISCOSITY | PRESSURE | CODE |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | .12779E-01 | .13105E-01 | .42000E-08 | .15000E+02 | 1 | 2 | .11923E-01 | .12158E-01 | .42000E-08 | .15073E+02 | 0 |
| 3 | .11108E-01 | .11250E-01 | .42000E-08 | .15151E+02 | 0 | 4 | .10363E-01 | .10412E-01 | .42000E-08 | .15236E+02 | 0 |
| 5 | .97089E-02 | .96664E-02 | .42000E-08 | .15328E+02 | 0 | 6 | .91613E-02 | .90264E-02 | .42000E-08 | .15426E+02 | 0 |
| 7 | .87282E-02 | .85010E-02 | .42000E-08 | .15532E+02 | 0 | 8 | .84120E-02 | .80926E-02 | .42000E-08 | .15645E+02 | 0 |
| 9 | .82102E-02 | .77988E-02 | .42000E-08 | .15764E+02 | 0 | 10 | .81157E-02 | .76125E-02 | .42000E-08 | .15888E+02 | 0 |
| 11 | .81176E-02 | .75228E-02 | .42000E-08 | .16017E+02 | 0 | 12 | .82017E-02 | .75157E-02 | .42000E-08 | .16148E+02 | 0 |
| 13 | .83513E-02 | .75745E-02 | .42000E-08 | .16282E+02 | 0 | 14 | .85477E-02 | .76804E-02 | .42000E-08 | .16415E+02 | 0 |
| 15 | .87709E-02 | .78136E-02 | .42000E-08 | .16550E+02 | 0 | 16 | .90001E-02 | .79534E-02 | .42000E-08 | .16683E+02 | 0 |
| 17 | .92146E-02 | .80789E-02 | .42000E-08 | .16817E+02 | 0 | 18 | .93941E-02 | .81701E-02 | .42000E-08 | .16949E+02 | 0 |
| 19 | .95196E-02 | .82080E-02 | .42000E-08 | .17084E+02 | 0 | 20 | .95740E-02 | .81754E-02 | .42000E-08 | .17219E+02 | 0 |
| 21 | .95424E-02 | .80576E-02 | .42000E-08 | .17360E+02 | 0 | 22 | .94132E-02 | .78430E-02 | .42000E-08 | .17506E+02 | 0 |
| 23 | .91786E-02 | .75238E-02 | .42000E-08 | .17665E+02 | 0 | 24 | .88348E-02 | .70963E-02 | .42000E-08 | .17837E+02 | 0 |
| 25 | .83834E-02 | .65621E-02 | .42000E-08 | .18032E+02 | 0 | 26 | .78313E-02 | .59282E-02 | .42000E-08 | .18255E+02 | 0 |
| 27 | .71918E-02 | .52079E-02 | .42000E-08 | .18516E+02 | 0 | 28 | .64850E-02 | .44214E-02 | .42000E-08 | .18819E+02 | 0 |
| 29 | .57386E-02 | .35964E-02 | .42000E-08 | .19162E+02 | 0 | 30 | .49884E-02 | .27687E-02 | .42000E-08 | .19469E+02 | 0 |
| 31 | .42789E-02 | .19829E-02 | .42000E-08 | .19614E+02 | 0 | 32 | .36641E-02 | .12930E-02 | .42000E-08 | .19316E+02 | 0 |
| 33 | .32079E-02 | .76298E-03 | .42000E-08 | .18036E+02 | 0 | 34 | .29851E-02 | .46761E-03 | .42000E-08 | .16078E+02 | 0 |
| 35 | .30814E-02 | .49283E-03 | .42000E-08 | .15000E+02 | 1 | | | | | | |

I = 3

| J | CLEARANCE | FILM THICK | VISCOSITY | PRESSURE | CODE | J | CLEARANCE | FILM THICK | VISCOSITY | PRESSURE | CODE |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | .12779E-01 | .13105E-01 | .42000E-08 | .15000E+02 | 1 | 2 | .11923E-01 | .12158E-01 | .42000E-08 | .15067E+02 | 0 |
| 3 | .11108E-01 | .11250E-01 | .42000E-08 | .15140E+02 | 0 | 4 | .10363E-01 | .10412E-01 | .42000E-08 | .15218E+02 | 0 |
| 5 | .97089E-02 | .96664E-02 | .42000E-08 | .15301E+02 | 0 | 6 | .91613E-02 | .90264E-02 | .42000E-08 | .15391E+02 | 0 |
| 7 | .87282E-02 | .85010E-02 | .42000E-08 | .15487E+02 | 0 | 8 | .84120E-02 | .80926E-02 | .42000E-08 | .15589E+02 | 0 |
| 9 | .82102E-02 | .77988E-02 | .42000E-08 | .15696E+02 | 0 | 10 | .81157E-02 | .76125E-02 | .42000E-08 | .15807E+02 | 0 |
| 11 | .81176E-02 | .75228E-02 | .42000E-08 | .15922E+02 | 0 | 12 | .82017E-02 | .75157E-02 | .42000E-08 | .16039E+02 | 0 |
| 13 | .83513E-02 | .75745E-02 | .42000E-08 | .16159E+02 | 0 | 14 | .85477E-02 | .76804E-02 | .42000E-08 | .16279E+02 | 0 |
| 15 | .87709E-02 | .78136E-02 | .42000E-08 | .16401E+02 | 0 | 16 | .90001E-02 | .79534E-02 | .42000E-08 | .16522E+02 | 0 |
| 17 | .92146E-02 | .80789E-02 | .42000E-08 | .16644E+02 | 0 | 18 | .93941E-02 | .81701E-02 | .42000E-08 | .16767E+02 | 0 |
| 19 | .95196E-02 | .82080E-02 | .42000E-08 | .16892E+02 | 0 | 20 | .95740E-02 | .81754E-02 | .42000E-08 | .17019E+02 | 0 |
| 21 | .95424E-02 | .80576E-02 | .42000E-08 | .17153E+02 | 0 | 22 | .94132E-02 | .78430E-02 | .42000E-08 | .17294E+02 | 0 |
| 23 | .91786E-02 | .75238E-02 | .42000E-08 | .17446E+02 | 0 | 24 | .88348E-02 | .70963E-02 | .42000E-08 | .17615E+02 | 0 |
| 25 | .83834E-02 | .65621E-02 | .42000E-08 | .17807E+02 | 0 | 26 | .78313E-02 | .59282E-02 | .42000E-08 | .18027E+02 | 0 |

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0 0 5 2 9

# FOIL 3

| | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 27 | .71918E-02 | .52079E-02 | .42000E-08 | .18287E+02 | 0 | 28 | .64850E-02 | .44214E-02 | .42000E-08 | .18591E+02 | 0 |
| 29 | .57396E-02 | .35964E-02 | .42000E-08 | .18936E+02 | 0 | 30 | .49884E-02 | .27687E-02 | .42000E-08 | .19248E+02 | 0 |
| 31 | .42780E-02 | .19823E-02 | .42000E-08 | .19404E+02 | 0 | 32 | .36641E-02 | .12930E-02 | .42000E-08 | .19131E+02 | 0 |
| 33 | .32079E-02 | .76298E-03 | .42000E-08 | .17900E+02 | 0 | 34 | .29851E-02 | .46761E-03 | .42000E-08 | .16016E+02 | 0 |
| 35 | .30814E-02 | .49283E-03 | .42000E-08 | .15000E+02 | 1 | | | | | | |

I = 4

| J | CLEARANCE | FILM THICK | VISCOSITY | PRESSURE | CODE | J | CLEARANCE | FILM THICK | VISCOSITY | PRESSURE | CODE |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | .12779E-01 | .13105E-01 | .42000E-08 | .15000E+02 | 1 | 2 | .11923E-01 | .12158E-01 | .42000E-08 | .15052E+02 | 0 |
| 3 | .11108E-01 | .11250E-01 | .42000E-08 | .15108E+02 | 0 | 4 | .10363E-01 | .10412E-01 | .42000E-08 | .15166E+02 | 0 |
| 5 | .97089E-02 | .96664E-02 | .42000E-08 | .15228E+02 | 0 | 6 | .91613E-02 | .90264E-02 | .42000E-08 | .15293E+02 | 0 |
| 7 | .87282E-02 | .85010E-02 | .42000E-08 | .15367E+02 | 0 | 8 | .84120E-02 | .80926E-02 | .42000E-08 | .15433E+02 | 0 |
| 9 | .82102E-02 | .77988E-02 | .42000E-08 | .15507E+02 | 0 | 10 | .81157E-02 | .76125E-02 | .42000E-08 | .15583E+02 | 0 |
| 11 | .81176E-02 | .75228E-02 | .42000E-08 | .15662E+02 | 0 | 12 | .82017E-02 | .75157E-02 | .42000E-08 | .15742E+02 | 0 |
| 13 | .83513E-02 | .75745E-02 | .42000E-08 | .15825E+02 | 0 | 14 | .85477E-02 | .76804E-02 | .42000E-08 | .15908E+02 | 0 |
| 15 | .87709E-02 | .78136E-02 | .42000E-08 | .15994E+02 | 0 | 16 | .90001E-02 | .79534E-02 | .42000E-08 | .16080E+02 | 0 |
| 17 | .92146E-02 | .80789E-02 | .42000E-08 | .16171E+02 | 0 | 18 | .93941E-02 | .81701E-02 | .42000E-08 | .16263E+02 | 0 |
| 19 | .95106E-02 | .82080E-02 | .42000E-08 | .16361E+02 | 0 | 20 | .95740E-02 | .81754E-02 | .42000E-08 | .16463E+02 | 0 |
| 21 | .95424E-02 | .80576E-02 | .42000E-08 | .16574E+02 | 0 | 22 | .94132E-02 | .78430E-02 | .42000E-08 | .16693E+02 | 0 |
| 23 | .91786E-02 | .75238E-02 | .42000E-08 | .16828E+02 | 0 | 24 | .88348E-02 | .70963E-02 | .42000E-08 | .16979E+02 | 0 |
| 25 | .83834E-02 | .65621E-02 | .42000E-08 | .17157E+02 | 0 | 26 | .78313E-02 | .59282E-02 | .42000E-08 | .17365E+02 | 0 |
| 27 | .71918E-02 | .52079E-02 | .42000E-08 | .17615E+02 | 0 | 28 | .64850E-02 | .44214E-02 | .42000E-08 | .17912E+02 | 0 |
| 29 | .57396E-02 | .35964E-02 | .42000E-08 | .18257E+02 | 0 | 30 | .49884E-02 | .27687E-02 | .42000E-08 | .18579E+02 | 0 |
| 31 | .42780E-02 | .19823E-02 | .42000E-08 | .18763E+02 | 0 | 32 | .36641E-02 | .12930E-02 | .42000E-08 | .18558E+02 | 0 |
| 33 | .32079E-02 | .76298E-03 | .42000E-08 | .17479E+02 | 0 | 34 | .29851E-02 | .46761E-03 | .42000E-08 | .15826E+02 | 0 |
| 35 | .30814E-02 | .49283E-03 | .42000E-08 | .15000E+02 | 1 | | | | | | |

I = 5

| J | CLEARANCE | FILM THICK | VISCOSITY | PRESSURE | CODE | J | CLEARANCE | FILM THICK | VISCOSITY | PRESSURE | CODE |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | .12779E-01 | .13105E-01 | .42000E-08 | .15000E+02 | 1 | 2 | .11923E-01 | .12158E-01 | .42000E-08 | .15000E+02 | 1 |
| 3 | .11108E-01 | .11250E-01 | .42000E-08 | .15000E+02 | 1 | 4 | .10363E-01 | .10412E-01 | .42000E-08 | .15000E+02 | 1 |
| 5 | .97089E-02 | .96664E-02 | .42000E-08 | .15000E+02 | 1 | 6 | .91613E-02 | .90264E-02 | .42000E-08 | .15000E+02 | 1 |
| 7 | .87282E-02 | .85010E-02 | .42000E-08 | .15000E+02 | 1 | 8 | .84120E-02 | .80926E-02 | .42000E-08 | .15000E+02 | 1 |
| 9 | .82102E-02 | .77988E-02 | .42000E-08 | .15000E+02 | 1 | 10 | .81157E-02 | .76125E-02 | .42000E-08 | .15000E+02 | 1 |
| 11 | .81176E-02 | .75228E-02 | .42000E-08 | .15000E+02 | 1 | 12 | .82017E-02 | .75157E-02 | .42000E-08 | .15000E+02 | 1 |
| 13 | .83513E-02 | .75745E-02 | .42000E-08 | .15000E+02 | 1 | 14 | .85477E-02 | .76804E-02 | .42000E-08 | .15000E+02 | 1 |
| 15 | .87709E-02 | .78136E-02 | .42000E-08 | .15000E+02 | 1 | 16 | .90001E-02 | .79534E-02 | .42000E-08 | .15000E+02 | 1 |
| 17 | .92146E-02 | .80789E-02 | .42000E-08 | .15000E+02 | 1 | 18 | .93941E-02 | .81701E-02 | .42000E-08 | .15000E+02 | 1 |
| 19 | .95106E-02 | .82080E-02 | .42000E-08 | .15000E+02 | 1 | 20 | .95740E-02 | .81754E-02 | .42000E-08 | .15000E+02 | 1 |
| 21 | .95424E-02 | .80576E-02 | .42000E-08 | .15000E+02 | 1 | 22 | .94132E-02 | .78430E-02 | .42000E-08 | .15000E+02 | 1 |
| 23 | .91786E-02 | .75238E-02 | .42000E-08 | .15000E+02 | 1 | 24 | .88348E-02 | .70963E-02 | .42000E-08 | .15000E+02 | 1 |
| 25 | .83834E-02 | .65621E-02 | .42000E-08 | .15000E+02 | 1 | 26 | .78313E-02 | .59282E-02 | .42000E-08 | .15000E+02 | 1 |
| 27 | .71918E-02 | .52079E-02 | .42000E-08 | .15000E+02 | 1 | 28 | .64850E-02 | .44214E-02 | .42000E-08 | .15000E+02 | 1 |
| 29 | .57396E-02 | .35964E-02 | .42000E-08 | .15000E+02 | 1 | 30 | .49884E-02 | .27687E-02 | .42000E-08 | .15000E+02 | 1 |
| 31 | .42780E-02 | .19823E-02 | .42000E-08 | .15000E+02 | 1 | 32 | .36641E-02 | .12930E-02 | .42000E-08 | .15000E+02 | 1 |
| 33 | .32079E-02 | .76298E-03 | .42000E-08 | .15000E+02 | 1 | 34 | .29851E-02 | .46761E-03 | .42000E-08 | .15000E+02 | 1 |
| 35 | .30814E-02 | .49283E-03 | .42000E-08 | .15000E+02 | 1 | | | | | | |

69
62500

HYDRODYNAMIC GAS OR LIQUID BEARING PROGRAM

ITERATION FOR VSTAR AT LIMIT FRICTION CALCULATIONS DELETED

* * * *

| | | |

| | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 29 | 15.00 | 3933.11 | 1519.20 | 400. | 2. | 30 | 15.00 | 3934.40 | 1277.64 | 308. | 1. |
| 31 | 15.00 | 3935.63 | 813.61 | 220. | 1. | 32 | 15.00 | 3936.69 | 465.67 | 144. | 1. |
| 33 | 15.00 | 3937.48 | 235.05 | 85. | 1. | 34 | 15.00 | 3937.86 | 114.80 | 52. | 1. |
| 35 | 15.00 | 3937.70 | 0.00 | 55. | 1. | | | | | | |



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# FOIL 4

I = 1

| J | CLEARANCE | FILM THICK | VISCOSITY | PRESSURE | CODE | J | CLEARANCE | FILM THICK | VISCOSITY | PRESSURE | CODE |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | .14081E-01 | .11493E-01 | .42000E-08 | .15000E+02 | 1 | 2 | .12751E-01 | .10092E-01 | .42000E-08 | .15076E+02 | 0 |
| 3 | .11548E-01 | .88215E-02 | .42000E-08 | .15158E+02 | 0 | 4 | .10492E-01 | .76988E-02 | .42000E-08 | .15247E+02 | 0 |
| 5 | .95953E-02 | .67362E-02 | .42000E-08 | .15343E+02 | 0 | 6 | .88630E-02 | .59400E-02 | .42000E-08 | .15446E+02 | 0 |
| 7 | .82964E-02 | .53110E-02 | .42000E-08 | .15556E+02 | 0 | 8 | .78912E-02 | .48451E-02 | .42000E-08 | .15672E+02 | 0 |
| 9 | .76302E-02 | .45340E-02 | .42000E-08 | .15792E+02 | 0 | 10 | .75281E-02 | .43655E-02 | .42000E-08 | .15918E+02 | 0 |
| 11 | .75428E-02 | .43244E-02 | .42000E-08 | .16046E+02 | 0 | 12 | .76652E-02 | .43928E-02 | .42000E-08 | .16179E+02 | 0 |
| 13 | .78754E-02 | .45507E-02 | .42000E-08 | .16313E+02 | 0 | 14 | .81518E-02 | .47766E-02 | .42000E-08 | .16449E+02 | 0 |
| 15 | .84719E-02 | .50479E-02 | .42000E-08 | .16585E+02 | 0 | 16 | .88127E-02 | .53418E-02 | .42000E-08 | .16722E+02 | 0 |
| 17 | .91513E-02 | .56354E-02 | .42000E-08 | .16859E+02 | 0 | 18 | .94656E-02 | .59066E-02 | .42000E-08 | .16998E+02 | 0 |
| 19 | .97347E-02 | .61344E-02 | .42000E-08 | .17137E+02 | 0 | 20 | .99393E-02 | .62997E-02 | .42000E-08 | .17281E+02 | 0 |
| 21 | .10063E-01 | .63857E-02 | .42000E-08 | .17429E+02 | 0 | 22 | .10091E-01 | .63783E-02 | .42000E-08 | .17586E+02 | 0 |
| 23 | .10013E-01 | .62670E-02 | .42000E-08 | .17754E+02 | 0 | 24 | .98226E-02 | .60453E-02 | .42000E-08 | .17940E+02 | 0 |
| 25 | .95178E-02 | .57111E-02 | .42000E-08 | .18151E+02 | 0 | 26 | .91015E-02 | .52675E-02 | .42000E-08 | .18403E+02 | 0 |
| 27 | .85824E-02 | .47230E-02 | .42000E-08 | .18715E+02 | 0 | 28 | .79752E-02 | .40925E-02 | .42000E-08 | .19124E+02 | 0 |
| 29 | .73014E-02 | .33976E-02 | .42000E-08 | .19692E+02 | 0 | 30 | .65900E-02 | .26670E-02 | .42000E-08 | .20457E+02 | 0 |
| 31 | .58775E-02 | .19375E-02 | .42000E-08 | .21488E+02 | 0 | 32 | .52090E-02 | .12541E-02 | .42000E-08 | .23314E+02 | 0 |
| 33 | .46384E-02 | .67071E-03 | .42000E-08 | .26491E+02 | 0 | 34 | .42291E-02 | .25078E-03 | .42000E-08 | .29419E+02 | 0 |
| 35 | .40547E-02 | .67802E-04 | .42000E-08 | .15000E+02 | 1 | | | | | | |

I = 2

| J | CLEARANCE | FILM THICK | VISCOSITY | PRESSURE | CODE | J | CLEARANCE | FILM THICK | VISCOSITY | PRESSURE | CODE |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | .14081E-01 | .11493E-01 | .42000E-08 | .15000E+02 | 1 | 2 | .12751E-01 | .10092E-01 | .42000E-08 | .15075E+02 | 0 |
| 3 | .11548E-01 | .88215E-02 | .42000E-08 | .15156E+02 | 0 | 4 | .10492E-01 | .76988E-02 | .42000E-08 | .15243E+02 | 0 |
| 5 | .95953E-02 | .67362E-02 | .42000E-08 | .15337E+02 | 0 | 6 | .88630E-02 | .59400E-02 | .42000E-08 | .15438E+02 | 0 |
| 7 | .82964E-02 | .53110E-02 | .42000E-08 | .15545E+02 | 0 | 8 | .78912E-02 | .48451E-02 | .42000E-08 | .15658E+02 | 0 |
| 9 | .76302E-02 | .45340E-02 | .42000E-08 | .15775E+02 | 0 | 10 | .75281E-02 | .43655E-02 | .42000E-08 | .15897E+02 | 0 |
| 11 | .75428E-02 | .43244E-02 | .42000E-08 | .16022E+02 | 0 | 12 | .76652E-02 | .43928E-02 | .42000E-08 | .16151E+02 | 0 |
| 13 | .78754E-02 | .45507E-02 | .42000E-08 | .16281E+02 | 0 | 14 | .81518E-02 | .47766E-02 | .42000E-08 | .16414E+02 | 0 |
| 15 | .84719E-02 | .50479E-02 | .42000E-08 | .16547E+02 | 0 | 16 | .88127E-02 | .53418E-02 | .42000E-08 | .16681E+02 | 0 |
| 17 | .91513E-02 | .56354E-02 | .42000E-08 | .16816E+02 | 0 | 18 | .94656E-02 | .59066E-02 | .42000E-08 | .16952E+02 | 0 |
| 19 | .97347E-02 | .61344E-02 | .42000E-08 | .17089E+02 | 0 | 20 | .99393E-02 | .62997E-02 | .42000E-08 | .17231E+02 | 0 |
| 21 | .10063E-01 | .63857E-02 | .42000E-08 | .17378E+02 | 0 | 22 | .10091E-01 | .63783E-02 | .42000E-08 | .17533E+02 | 0 |
| 23 | .10013E-01 | .62670E-02 | .42000E-08 | .17700E+02 | 0 | 24 | .98226E-02 | .60453E-02 | .42000E-08 | .17885E+02 | 0 |
| 25 | .95178E-02 | .57111E-02 | .42000E-08 | .18096E+02 | 0 | 26 | .91015E-02 | .52675E-02 | .42000E-08 | .18347E+02 | 0 |
| 27 | .85824E-02 | .47230E-02 | .42000E-08 | .18658E+02 | 0 | 28 | .79752E-02 | .40925E-02 | .42000E-08 | .19067E+02 | 0 |
| 29 | .73014E-02 | .33976E-02 | .42000E-08 | .19635E+02 | 0 | 30 | .65900E-02 | .26670E-02 | .42000E-08 | .20400E+02 | 0 |
| 31 | .58775E-02 | .19375E-02 | .42000E-08 | .21431E+02 | 0 | 32 | .52090E-02 | .12541E-02 | .42000E-08 | .23257E+02 | 0 |
| 33 | .46384E-02 | .67071E-03 | .42000E-08 | .26434E+02 | 0 | 34 | .42291E-02 | .25078E-03 | .42000E-08 | .29367E+02 | 0 |
| 35 | .40547E-02 | .67802E-04 | .42000E-08 | .15000E+02 | 1 | | | | | | |

I = 3

| J | CLEARANCE | FILM THICK | VISCOSITY | PRESSURE | CODE | J | CLEARANCE | FILM THICK | VISCOSITY | PRESSURE | CODE |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | .14081E-01 | .11493E-01 | .42000E-08 | .15000E+02 | 1 | 2 | .12751E-01 | .10092E-01 | .42000E-08 | .15070E+02 | 0 |
| 3 | .11548E-01 | .88215E-02 | .42000E-08 | .15146E+02 | 0 | 4 | .10492E-01 | .76988E-02 | .42000E-08 | .15226E+02 | 0 |
| 5 | .95953E-02 | .67362E-02 | .42000E-08 | .15313E+02 | 0 | 6 | .88630E-02 | .59400E-02 | .42000E-08 | .15404E+02 | 0 |
| 7 | .82964E-02 | .53110E-02 | .42000E-08 | .15501E+02 | 0 | 8 | .78912E-02 | .48451E-02 | .42000E-08 | .15601E+02 | 0 |
| 9 | .76302E-02 | .45340E-02 | .42000E-08 | .15706E+02 | 0 | 10 | .75281E-02 | .43655E-02 | .42000E-08 | .15814E+02 | 0 |
| 11 | .75428E-02 | .43244E-02 | .42000E-08 | .15925E+02 | 0 | 12 | .76652E-02 | .43928E-02 | .42000E-08 | .16039E+02 | 0 |
| 13 | .78754E-02 | .45507E-02 | .42000E-08 | .16155E+02 | 0 | 14 | .81518E-02 | .47766E-02 | .42000E-08 | .16274E+02 | 0 |
| 15 | .84719E-02 | .50479E-02 | .42000E-08 | .16394E+02 | 0 | 16 | .88127E-02 | .53418E-02 | .42000E-08 | .16517E+02 | 0 |
| 17 | .91513E-02 | .56354E-02 | .42000E-08 | .16641E+02 | 0 | 18 | .94656E-02 | .59066E-02 | .42000E-08 | .16767E+02 | 0 |
| 19 | .97347E-02 | .61344E-02 | .42000E-08 | .16896E+02 | 0 | 20 | .99393E-02 | .62997E-02 | .42000E-08 | .17031E+02 | 0 |
| 21 | .10063E-01 | .63857E-02 | .42000E-08 | .17171E+02 | 0 | 22 | .10091E-01 | .63783E-02 | .42000E-08 | .17320E+02 | 0 |
| 23 | .10013E-01 | .62670E-02 | .42000E-08 | .17482E+02 | 0 | 24 | .98226E-02 | .60453E-02 | .42000E-08 | .17663E+02 | 0 |
| 25 | .95178E-02 | .57111E-02 | .42000E-08 | .17871E+02 | 0 | 26 | .91015E-02 | .52675E-02 | .42000E-08 | .18119E+02 | 0 |

| | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| 27 | .958246E-02 | .472306E-02 | .420006E-08 | .184286E+02 | 0 | 28 | .797526E-02 | .409256E-02 | .420006E-08 | .188356E+02 | 0 |
| 29 | .738146E-02 | .339766E-02 | .420006E-08 | .194026E+02 | 0 | 30 | .659006E-02 | .266706E-02 | .420006E-08 | .201666E+02 | 0 |
| 31 | .587756E-02 | .193756E-02 | .420006E-08 | .211976E+02 | 0 | 32 | .520906E-02 | .125416E-02 | .420006E-08 | .230206E+02 | 0 |
| 33 | .463846E-02 | .670716E-03 | .420006E-08 | .261966E+02 | 0 | 34 | .422916E-02 | .250786E-03 | .420006E-08 | .291566E+02 | 0 |
| 35 | .405476E-02 | .678026E-04 | .420006E-08 | .150006E+02 | 1 | | | | | | |

I = 4

| J | CLEARANCE | FILM THICK | VISCOSITY | PRESSURE | CODE | J | CLEARANCE | FILM THICK | VISCOSITY | PRESSURE | CODE |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | .140016E-01 | .114936E-01 | .420006E-08 | .150006E+02 | 1 | 2 | .127516E-01 | .100926E-01 | .420006E-08 | .150576E+02 | 0 |
| 3 | .115486E-01 | .882156E-02 | .420006E-08 | .151176E+02 | 0 | 4 | .104926E-01 | .769886E-02 | .420006E-08 | .151796E+02 | 0 |
| 5 | .959536E-02 | .678626E-02 | .420006E-08 | .152446E+02 | 0 | 6 | .886306E-02 | .594006E-02 | .420006E-08 | .153106E+02 | 0 |
| 7 | .829646E-02 | .541106E-02 | .420006E-08 | .153786E+02 | 0 | 8 | .789126E-02 | .484516E-02 | .420006E-08 | .154466E+02 | 0 |
| 9 | .763926E-02 | .453406E-02 | .420006E-08 | .155166E+02 | 0 | 10 | .752816E-02 | .436556E-02 | .420006E-08 | .155866E+02 | 0 |
| 11 | .754386E-02 | .442446E-02 | .420006E-08 | .156566E+02 | 0 | 12 | .766526E-02 | .439286E-02 | .420006E-08 | .157336E+02 | 0 |
| 13 | .787546E-02 | .455076E-02 | .420006E-08 | .158116E+02 | 0 | 14 | .815186E-02 | .477666E-02 | .420006E-08 | .158936E+02 | 0 |
| 15 | .847196E-02 | .506796E-02 | .420006E-08 | .159786E+02 | 0 | 16 | .881276E-02 | .534186E-02 | .420006E-08 | .160686E+02 | 0 |
| 17 | .915136E-02 | .568546E-02 | .420006E-08 | .161606E+02 | 0 | 18 | .946566E-02 | .590666E-02 | .420006E-08 | .162596E+02 | 0 |
| 19 | .973476E-02 | .613446E-02 | .420006E-08 | .163616E+02 | 0 | 20 | .993936E-02 | .629976E-02 | .420006E-08 | .164716E+02 | 0 |
| 21 | .100636E-01 | .638576E-02 | .420006E-08 | .165886E+02 | 0 | 22 | .100916E-01 | .637836E-02 | .420006E-08 | .167186E+02 | 0 |
| 23 | .100136E-01 | .626706E-02 | .420006E-08 | .168606E+02 | 0 | 24 | .982266E-02 | .604536E-02 | .420006E-08 | .170246E+02 | 0 |
| 25 | .951786E-02 | .571116E-02 | .420006E-08 | .172156E+02 | 0 | 26 | .910156E-02 | .526756E-02 | .420006E-08 | .174486E+02 | 0 |
| 27 | .858246E-02 | .472306E-02 | .420006E-08 | .177436E+02 | 0 | 28 | .797526E-02 | .409256E-02 | .420006E-08 | .181376E+02 | 0 |
| 29 | .738146E-02 | .339766E-02 | .420006E-08 | .186506E+02 | 0 | 30 | .659006E-02 | .266706E-02 | .420006E-08 | .194426E+02 | 0 |
| 31 | .587756E-02 | .193756E-02 | .420006E-08 | .204596E+02 | 0 | 32 | .520906E-02 | .125416E-02 | .420006E-08 | .222706E+02 | 0 |
| 33 | .463846E-02 | .670716E-03 | .420006E-08 | .254316E+02 | 0 | 34 | .422916E-02 | .250786E-03 | .420006E-08 | .284626E+02 | 0 |
| 35 | .405476E-02 | .678026E-04 | .420006E-08 | .150006E+02 | 1 | | | | | | |

I = 5

| J | CLEARANCE | FILM THICK | VISCOSITY | PRESSURE | CODE | J | CLEARANCE | FILM THICK | VISCOSITY | PRESSURE | CODE |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | .140016E-01 | .114936E-01 | .420006E-08 | .150006E+02 | 1 | 2 | .127516E-01 | .100926E-01 | .420006E-08 | .150006E+02 | 1 |
| 3 | .115486E-01 | .882156E-02 | .420006E-08 | .150006E+02 | 1 | 4 | .104926E-01 | .769886E-02 | .420006E-08 | .150006E+02 | 1 |
| 5 | .959536E-02 | .678626E-02 | .420006E-08 | .150006E+02 | 1 | 6 | .886306E-02 | .594006E-02 | .420006E-08 | .150006E+02 | 1 |
| 7 | .829646E-02 | .541106E-02 | .420006E-08 | .150006E+02 | 1 | 8 | .789126E-02 | .484516E-02 | .420006E-08 | .150006E+02 | 1 |
| 9 | .763926E-02 | .453406E-02 | .420006E-08 | .150006E+02 | 1 | 10 | .752816E-02 | .436556E-02 | .420006E-08 | .150006E+02 | 1 |
| 11 | .754386E-02 | .442446E-02 | .420006E-08 | .150006E+02 | 1 | 12 | .766526E-02 | .439286E-02 | .420006E-08 | .150006E+02 | 1 |
| 13 | .787546E-02 | .455076E-02 | .420006E-08 | .150006E+02 | 1 | 14 | .815186E-02 | .477666E-02 | .420006E-08 | .150006E+02 | 1 |
| 15 | .847196E-02 | .506796E-02 | .420006E-08 | .150006E+02 | 1 | 16 | .881276E-02 | .534186E-02 | .420006E-08 | .150006E+02 | 1 |
| 17 | .915136E-02 | .568546E-02 | .420006E-08 | .150006E+02 | 1 | 18 | .946566E-02 | .590666E-02 | .420006E-08 | .150006E+02 | 1 |
| 19 | .973476E-02 | .613446E-02 | .420006E-08 | .150006E+02 | 1 | 20 | .993936E-02 | .629976E-02 | .420006E-08 | .150006E+02 | 1 |
| 21 | .100636E-01 | .638576E-02 | .420006E-08 | .150006E+02 | 1 | 22 | .100916E-01 | .637836E-02 | .420006E-08 | .150006E+02 | 1 |
| 23 | .100136E-01 | .626706E-02 | .420006E-08 | .150006E+02 | 1 | 24 | .982266E-02 | .604536E-02 | .420006E-08 | .150006E+02 | 1 |
| 25 | .951786E-02 | .571116E-02 | .420006E-08 | .150006E+02 | 1 | 26 | .910156E-02 | .526756E-02 | .420006E-08 | .150006E+02 | 1 |
| 27 | .858246E-02 | .472306E-02 | .420006E-08 | .150006E+02 | 1 | 28 | .797526E-02 | .409256E-02 | .420006E-08 | .150006E+02 | 1 |
| 29 | .738146E-02 | .339766E-02 | .420006E-08 | .150006E+02 | 1 | 30 | .659006E-02 | .266706E-02 | .420006E-08 | .150006E+02 | 1 |
| 31 | .587756E-02 | .193756E-02 | .420006E-08 | .150006E+02 | 1 | 32 | .520906E-02 | .125416E-02 | .420006E-08 | .150006E+02 | 1 |
| 33 | .463846E-02 | .670716E-03 | .420006E-08 | .150006E+02 | 1 | 34 | .422916E-02 | .250786E-03 | .420006E-08 | .150006E+02 | 1 |
| 35 | .405476E-02 | .678026E-04 | .420006E-08 | .150006E+02 | 1 | | | | | | |



82500

HYDRODYNAMIC GAS OR LIQUID BEARING PROGRAM

ITERATION FOR VSTAR AT LIMIT FRICTION CALCULATIONS DELETED

* * * *

62500

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 29 | 15.00 | 3931.04 | 1446.60 | 372. | 2. | 30 | 15.00 | 3931.04 | 1446.60 | 296. | 1. | |
| 31 | 15.00 | 3932.47 | 947.26 | 215. | 1. | 32 | 15.00 | 3934.02 | 570.71 | 139. | 1. | |
| 33 | 15.00 | 3935.01 | 271.74 | 75. | 1. | 34 | 15.00 | 3935.71 | 89.05 | 28. | 1. | |
| 35 | 15.00 | 3936.02 | 0.00 | 8. | 1. | | | | | | | |



62500

# FOIL 5

I = 1

| J | CLEARANCE | FILM THICK | VISCOSITY | PRESSURE | CODE | J | CLEARANCE | FILM THICK | VISCOSITY | PRESSURE | CODE |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | .15055E-01 | .11068E-01 | .42000E-08 | .15000E+02 | 1 | 2 | .13399E-01 | .94053E-02 | .42000E-08 | .15090E+02 | 0 |
| 3 | .11910E-01 | .79120E-02 | .42000E-08 | .15192E+02 | 0 | 4 | .10604E-01 | .66045E-02 | .42000E-08 | .15305E+02 | 0 |
| 5 | .94924E-02 | .54927E-02 | .42000E-08 | .15428E+02 | 0 | 6 | .85780E-02 | .45804E-02 | .42000E-08 | .15555E+02 | 0 |
| 7 | .78593E-02 | .38659E-02 | .42000E-08 | .15679E+02 | 0 | 8 | .73296E-02 | .33427E-02 | .42000E-08 | .15793E+02 | 0 |
| 9 | .69781E-02 | .29998E-02 | .42000E-08 | .15890E+02 | 0 | 10 | .67900E-02 | .28223E-02 | .42000E-08 | .15973E+02 | 0 |
| 11 | .67474E-02 | .27924E-02 | .42000E-08 | .16052E+02 | 0 | 12 | .68296E-02 | .28896E-02 | .42000E-08 | .16138E+02 | 0 |
| 13 | .70142E-02 | .30912E-02 | .42000E-08 | .16241E+02 | 0 | 14 | .72771E-02 | .33732E-02 | .42000E-08 | .16362E+02 | 0 |
| 15 | .75934E-02 | .37107E-02 | .42000E-08 | .16501E+02 | 0 | 16 | .79379E-02 | .40784E-02 | .42000E-08 | .16651E+02 | 0 |
| 17 | .82856E-02 | .44515E-02 | .42000E-08 | .16809E+02 | 0 | 18 | .86126E-02 | .48058E-02 | .42000E-08 | .16971E+02 | 0 |
| 19 | .89061E-02 | .51187E-02 | .42000E-08 | .17138E+02 | 0 | 20 | .91155E-02 | .53696E-02 | .42000E-08 | .17309E+02 | 0 |
| 21 | .92529E-02 | .55404E-02 | .42000E-08 | .17488E+02 | 0 | 22 | .92934E-02 | .56163E-02 | .42000E-08 | .17679E+02 | 0 |
| 23 | .92259E-02 | .55862E-02 | .42000E-08 | .17888E+02 | 0 | 24 | .90437E-02 | .54433E-02 | .42000E-08 | .18123E+02 | 0 |
| 25 | .87450E-02 | .51858E-02 | .42000E-08 | .18397E+02 | 0 | 26 | .83333E-02 | .48173E-02 | .42000E-08 | .18728E+02 | 0 |
| 27 | .78134E-02 | .43475E-02 | .42000E-08 | .19144E+02 | 0 | 28 | .72168E-02 | .37927E-02 | .42000E-08 | .19692E+02 | 0 |
| 29 | .65526E-02 | .31766E-02 | .42000E-08 | .20449E+02 | 0 | 30 | .58554E-02 | .25305E-02 | .42000E-08 | .21471E+02 | 0 |
| 31 | .51668E-02 | .18942E-02 | .42000E-08 | .22870E+02 | 0 | 32 | .45350E-02 | .13165E-02 | .42000E-08 | .25568E+02 | 0 |
| 33 | .40183E-02 | .85553E-03 | .42000E-08 | .31733E+02 | 0 | 34 | .36851E-02 | .57982E-03 | .42000E-08 | .51899E+02 | 0 |
| 35 | .36146E-02 | .56844E-03 | .42000E-08 | .15000E+02 | 1 | | | | | | |

I = 2

| J | CLEARANCE | FILM THICK | VISCOSITY | PRESSURE | CODE | J | CLEARANCE | FILM THICK | VISCOSITY | PRESSURE | CODE |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | .15055E-01 | .11068E-01 | .42000E-08 | .15000E+02 | 1 | 2 | .13399E-01 | .94053E-02 | .42000E-08 | .15090E+02 | 0 |
| 3 | .11910E-01 | .79120E-02 | .42000E-08 | .15191E+02 | 0 | 4 | .10604E-01 | .66045E-02 | .42000E-08 | .15303E+02 | 0 |
| 5 | .94924E-02 | .54927E-02 | .42000E-08 | .15424E+02 | 0 | 6 | .85780E-02 | .45804E-02 | .42000E-08 | .15549E+02 | 0 |
| 7 | .78593E-02 | .38659E-02 | .42000E-08 | .15671E+02 | 0 | 8 | .73296E-02 | .33427E-02 | .42000E-08 | .15781E+02 | 0 |
| 9 | .69781E-02 | .29998E-02 | .42000E-08 | .15875E+02 | 0 | 10 | .67900E-02 | .28223E-02 | .42000E-08 | .15954E+02 | 0 |
| 11 | .67474E-02 | .27924E-02 | .42000E-08 | .16028E+02 | 0 | 12 | .68296E-02 | .28896E-02 | .42000E-08 | .16109E+02 | 0 |
| 13 | .70142E-02 | .30912E-02 | .42000E-08 | .16208E+02 | 0 | 14 | .72771E-02 | .33732E-02 | .42000E-08 | .16326E+02 | 0 |
| 15 | .75934E-02 | .37107E-02 | .42000E-08 | .16461E+02 | 0 | 16 | .79379E-02 | .40784E-02 | .42000E-08 | .16608E+02 | 0 |
| 17 | .82856E-02 | .44515E-02 | .42000E-08 | .16763E+02 | 0 | 18 | .86126E-02 | .48058E-02 | .42000E-08 | .16923E+02 | 0 |
| 19 | .89061E-02 | .51187E-02 | .42000E-08 | .17088E+02 | 0 | 20 | .91155E-02 | .53696E-02 | .42000E-08 | .17258E+02 | 0 |
| 21 | .92529E-02 | .55404E-02 | .42000E-08 | .17436E+02 | 0 | 22 | .92934E-02 | .56163E-02 | .42000E-08 | .17625E+02 | 0 |
| 23 | .92259E-02 | .55862E-02 | .42000E-08 | .17833E+02 | 0 | 24 | .90437E-02 | .54433E-02 | .42000E-08 | .18067E+02 | 0 |
| 25 | .87450E-02 | .51858E-02 | .42000E-08 | .18341E+02 | 0 | 26 | .83333E-02 | .48173E-02 | .42000E-08 | .18671E+02 | 0 |
| 27 | .78134E-02 | .43475E-02 | .42000E-08 | .19086E+02 | 0 | 28 | .72168E-02 | .37927E-02 | .42000E-08 | .19634E+02 | 0 |
| 29 | .65526E-02 | .31766E-02 | .42000E-08 | .20391E+02 | 0 | 30 | .58554E-02 | .25305E-02 | .42000E-08 | .21412E+02 | 0 |
| 31 | .51668E-02 | .18942E-02 | .42000E-08 | .22810E+02 | 0 | 32 | .45350E-02 | .13165E-02 | .42000E-08 | .25507E+02 | 0 |
| 33 | .40183E-02 | .85553E-03 | .42000E-08 | .31670E+02 | 0 | 34 | .36851E-02 | .57982E-03 | .42000E-08 | .51831E+02 | 0 |
| 35 | .36146E-02 | .56844E-03 | .42000E-08 | .15000E+02 | 1 | | | | | | |

I = 3

| J | CLEARANCE | FILM THICK | VISCOSITY | PRESSURE | CODE | J | CLEARANCE | FILM THICK | VISCOSITY | PRESSURE | CODE |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | .15055E-01 | .11068E-01 | .42000E-08 | .15000E+02 | 1 | 2 | .13399E-01 | .94053E-02 | .42000E-08 | .15087E+02 | 0 |
| 3 | .11910E-01 | .79120E-02 | .42000E-08 | .15185E+02 | 0 | 4 | .10604E-01 | .66045E-02 | .42000E-08 | .15292E+02 | 0 |
| 5 | .94924E-02 | .54927E-02 | .42000E-08 | .15407E+02 | 0 | 6 | .85780E-02 | .45804E-02 | .42000E-08 | .15525E+02 | 0 |
| 7 | .78593E-02 | .38659E-02 | .42000E-08 | .15637E+02 | 0 | 8 | .73296E-02 | .33427E-02 | .42000E-08 | .15734E+02 | 0 |
| 9 | .69781E-02 | .29998E-02 | .42000E-08 | .15813E+02 | 0 | 10 | .67900E-02 | .28223E-02 | .42000E-08 | .15874E+02 | 0 |
| 11 | .67474E-02 | .27924E-02 | .42000E-08 | .15930E+02 | 0 | 12 | .68296E-02 | .28896E-02 | .42000E-08 | .15993E+02 | 0 |
| 13 | .70142E-02 | .30912E-02 | .42000E-08 | .16075E+02 | 0 | 14 | .72771E-02 | .33732E-02 | .42000E-08 | .16177E+02 | 0 |
| 15 | .75934E-02 | .37107E-02 | .42000E-08 | .16299E+02 | 0 | 16 | .79379E-02 | .40784E-02 | .42000E-08 | .16434E+02 | 0 |
| 17 | .82856E-02 | .44515E-02 | .42000E-08 | .16579E+02 | 0 | 18 | .86126E-02 | .48058E-02 | .42000E-08 | .16731E+02 | 0 |
| 19 | .89061E-02 | .51187E-02 | .42000E-08 | .16888E+02 | 0 | 20 | .91155E-02 | .53696E-02 | .42000E-08 | .17051E+02 | 0 |
| 21 | .92529E-02 | .55404E-02 | .42000E-08 | .17223E+02 | 0 | 22 | .92934E-02 | .56163E-02 | .42000E-08 | .17407E+02 | 0 |
| 23 | .92259E-02 | .55862E-02 | .42000E-08 | .17611E+02 | 0 | 24 | .90437E-02 | .54433E-02 | .42000E-08 | .17841E+02 | 0 |
| 25 | .87450E-02 | .51858E-02 | .42000E-08 | .18111E+02 | 0 | 26 | .83333E-02 | .48173E-02 | .42000E-08 | .18439E+02 | 0 |

| | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 27 | .78184E-02 | .43475E-02 | .42000E-08 | .18831E+02 | 0 | 28 | .72168E-02 | .37927E-02 | .42000E-08 | .19397E+02 | 0 |
| 29 | .65520E-02 | .31766E-02 | .42000E-08 | .20151E+02 | 0 | 30 | .58554E-02 | .25305E-02 | .42000E-08 | .21170E+02 | 0 |
| 31 | .51668E-02 | .18942E-02 | .42000E-08 | .22565E+02 | 0 | 32 | .45350E-02 | .13165E-02 | .42000E-08 | .25257E+02 | 0 |
| 33 | .40183E-02 | .85553E-03 | .42000E-08 | .31408E+02 | 0 | 34 | .36851E-02 | .57982E-03 | .42000E-08 | .51553E+02 | 0 |
| 35 | .36146E-02 | .56844E-03 | .42000E-08 | .15000E+02 | 1 | | | | | | |

I = 4

| J | CLEARANCE | FILM THICK | VISCOSITY | PRESSURE | CODE | J | CLEARANCE | FILM THICK | VISCOSITY | PRESSURE | CODE |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | .15055E-01 | .11068E-01 | .42000E-08 | .15000E+02 | 1 | 2 | .13399E-01 | .94053E-02 | .42000E-08 | .15080F+02 | 0 |
| 3 | .11910E-01 | .79120E-02 | .42000E-08 | .15167E+02 | 0 | 4 | .10604E-01 | .66045E-02 | .42000E-08 | .15260F+02 | 0 |
| 5 | .94924E-02 | .54927E-02 | .42000E-08 | .15358E+02 | 0 | 6 | .85780E-02 | .45804E-02 | .42000E-08 | .15453F+02 | 0 |
| 7 | .78593E-02 | .38659E-02 | .42000E-08 | .15537E+02 | 0 | 8 | .73296E-02 | .33427E-02 | .42000E-08 | .15601F+02 | 0 |
| 9 | .69781E-02 | .29998E-02 | .42000E-08 | .15640E+02 | 0 | 10 | .67900E-02 | .28223E-02 | .42000E-08 | .15657F+02 | 0 |
| 11 | .67474E-02 | .27924E-02 | .42000E-08 | .15665E+02 | 0 | 12 | .68296E-02 | .28896E-02 | .42000E-08 | .15681F+02 | 0 |
| 13 | .70142E-02 | .30912E-02 | .42000E-08 | .15717E+02 | 0 | 14 | .72771E-02 | .33732E-02 | .42000E-08 | .15777F+02 | 0 |
| 15 | .75936E-02 | .37107E-02 | .42000E-08 | .15861E+02 | 0 | 16 | .79379E-02 | .40784E-02 | .42000E-08 | .15962F+02 | 0 |
| 17 | .82856E-02 | .44515E-02 | .42000E-08 | .16076E+02 | 0 | 18 | .86126E-02 | .48058E-02 | .42000E-08 | .16199F+02 | 0 |
| 19 | .88961E-02 | .51187E-02 | .42000E-08 | .16332E+02 | 0 | 20 | .91155E-02 | .53696E-02 | .42000E-08 | .16471F+02 | 0 |
| 21 | .92529E-02 | .55404E-02 | .42000E-08 | .16621E+02 | 0 | 22 | .92934E-02 | .56163E-02 | .42000E-08 | .16784F+02 | 0 |
| 23 | .92259E-02 | .55862E-02 | .42000E-08 | .16968E+02 | 0 | 24 | .90437E-02 | .54433E-02 | .42000E-08 | .17179F+02 | 0 |
| 25 | .87450E-02 | .51858E-02 | .42000E-08 | .17430E+02 | 0 | 26 | .83333E-02 | .48173E-02 | .42000E-08 | .17738F+02 | 0 |
| 27 | .78184E-02 | .43475E-02 | .42000E-08 | .18131E+02 | 0 | 28 | .72168E-02 | .37927E-02 | .42000E-08 | .18656F+02 | 0 |
| 29 | .65520E-02 | .31766E-02 | .42000E-08 | .19389E+02 | 0 | 30 | .58554E-02 | .25305E-02 | .42000E-08 | .20386F+02 | 0 |
| 31 | .51668E-02 | .18942E-02 | .42000E-08 | .21761E+02 | 0 | 32 | .45350E-02 | .13165E-02 | .42000E-08 | .24422F+02 | 0 |
| 33 | .40183E-02 | .85553E-03 | .42000E-08 | .30520E+02 | 0 | 34 | .36851E-02 | .57982E-03 | .42000E-08 | .50600F+02 | 0 |
| 35 | .36146E-02 | .56844E-03 | .42000E-08 | .15000E+02 | 1 | | | | | | |

I = 5

| J | CLEARANCE | FILM THICK | VISCOSITY | PRESSURE | CODE | J | CLEARANCE | FILM THICK | VISCOSITY | PRESSURE | CODE |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | .15055E-01 | .11068E-01 | .42000E-08 | .15000E+02 | 1 | 2 | .13399E-01 | .94053E-02 | .42000E-08 | .15000F+02 | 1 |
| 3 | .11910E-01 | .79120E-02 | .42000E-08 | .15000E+02 | 1 | 4 | .10604E-01 | .66045E-02 | .42000E-08 | .15000F+02 | 1 |
| 5 | .94924E-02 | .54927E-02 | .42000E-08 | .15000E+02 | 1 | 6 | .85780E-02 | .45804E-02 | .42000E-08 | .15000F+02 | 1 |
| 7 | .78593E-02 | .38659E-02 | .42000E-08 | .15000E+02 | 1 | 8 | .73296E-02 | .33427E-02 | .42000E-08 | .15000F+02 | 1 |
| 9 | .69781E-02 | .29998E-02 | .42000E-08 | .15000E+02 | 1 | 10 | .67900E-02 | .28223E-02 | .42000E-08 | .15000F+02 | 1 |
| 11 | .67474E-02 | .27924E-02 | .42000E-08 | .15000E+02 | 1 | 12 | .68296E-02 | .28896E-02 | .42000E-08 | .15000F+02 | 1 |
| 13 | .70142E-02 | .30912E-02 | .42000E-08 | .15000E+02 | 1 | 14 | .72771E-02 | .33732E-02 | .42000E-08 | .15000F+02 | 1 |
| 15 | .75936E-02 | .37107E-02 | .42000E-08 | .15000E+02 | 1 | 16 | .79379E-02 | .40784E-02 | .42000E-08 | .15000F+02 | 1 |
| 17 | .82856E-02 | .44515E-02 | .42000E-08 | .15000E+02 | 1 | 18 | .86126E-02 | .48058E-02 | .42000E-08 | .15000F+02 | 1 |
| 19 | .88961E-02 | .51187E-02 | .42000E-08 | .15000E+02 | 1 | 20 | .91155E-02 | .53696E-02 | .42000E-08 | .15000F+02 | 1 |
| 21 | .92529E-02 | .55404E-02 | .42000E-08 | .15000E+02 | 1 | 22 | .92934E-02 | .56163E-02 | .42000E-08 | .15000F+02 | 1 |
| 23 | .92259E-02 | .55862E-02 | .42000E-08 | .15000E+02 | 1 | 24 | .90437E-02 | .54433E-02 | .42000E-08 | .15000F+02 | 1 |
| 25 | .87450E-02 | .51858E-02 | .42000E-08 | .15000E+02 | 1 | 26 | .83333E-02 | .48173E-02 | .42000E-08 | .15000F+02 | 1 |
| 27 | .78184E-02 | .43475E-02 | .42000E-08 | .15000E+02 | 1 | 28 | .72168E-02 | .37927E-02 | .42000E-08 | .15000F+02 | 1 |
| 29 | .65520E-02 | .31766E-02 | .42000E-08 | .15000E+02 | 1 | 30 | .58554E-02 | .25305E-02 | .42000E-08 | .15000F+02 | 1 |
| 31 | .51668E-02 | .18942E-02 | .42000E-08 | .15000E+02 | 1 | 32 | .45350E-02 | .13165E-02 | .42000E-08 | .15000F+02 | 1 |
| 33 | .40183E-02 | .85553E-03 | .42000E-08 | .15000E+02 | 1 | 34 | .36851E-02 | .57982E-03 | .42000E-08 | .15000F+02 | 1 |
| 35 | .36146E-02 | .56844E-03 | .42000E-08 | .15000E+02 | 1 | | | | | | |

HYDRODYNAMIC GAS OR LIQUID BEARING PROGRAM

ITERATION FOR VSTAR AT LIMIT FRICTION CALCULATIONS DELETED

* * * \

| | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| 17 | [illegible] | [illegible] | [illegible] | [illegible] | 2. | 18 | 17.74 | 2485.89 | 65.08 | 533. | 2. |
| 19 | 17.03 | 2285.86 | 7.40 | 568. | 2. | 20 | 17.29 | 2112.42 | 85.35 | 596. | 2. |
| 21 | 17.54 | 1965.43 | 92.65 | 615. | 2. | 22 | 17.81 | 1796.55 | 96.87 | 623. | 2. |
| 23 | 18.09 | 1648.81 | 97.55 | 623. | 2. | 24 | 18.41 | 1513.09 | 94.24 | 604. | 2. |
| 25 | 18.75 | 1381.27 | 87.18 | 575. | 2. | 26 | 19.16 | 1301.58 | 76.72 | 535. | 2. |
| 27 | 19.64 | 1237.87 | 63.88 | 483. | 2. | 28 | 20.25 | 1256.51 | 49.76 | 421. | 2. |
| 29 | 21.02 | 1473.84 | 35.82 | 353. | 2. | 30 | 22.00 | 1332.97 | 26.67 | 281. | 1. |
| 31 | 23.15 | 1907.25 | 15.03 | 211. | 1. | 32 | 24.96 | 2509.65 | 7.28 | 146. | 1. |
| 33 | 27.46 | 3429.25 | 3.63 | 95. | 1. | 34 | 28.59 | 4736.04 | 1.19 | 64. | 1. |
| 35 | 15.00 | 6520.50 | 0.00 | 63. | 1. | | | | | | |

I = 3

| J | P | U BAR | W BAR | RE | CODE | J | P | U BAR | W BAR | RE | CODE |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 15.00 | 1395.55 | 0.00 | 1225. | 2. | 2 | 15.11 | 1560.87 | 5.31 | 1041. | 2. |
| 3 | 15.25 | 1412.65 | 9.33 | 877. | 2. | 4 | 15.42 | 2107.97 | 12.09 | 732. | 2. |
| 5 | 15.51 | 2452.56 | 13.91 | 609. | 2. | 6 | 15.81 | 2843.30 | 15.24 | 508. | 2. |
| 7 | 16.01 | 3262.93 | 16.60 | 429. | 2. | 8 | 16.15 | 3680.13 | 18.62 | 371. | 2. |
| 9 | 16.17 | 4016.86 | 24.42 | 333. | 1. | 10 | 16.10 | 4247.63 | 28.27 | 313. | 1. |
| 11 | 15.96 | 4311.97 | 35.24 | 310. | 1. | 12 | 15.84 | 4212.98 | 46.13 | 321. | 1. |
| 13 | 15.79 | 3974.56 | 61.65 | 343. | 1. | 14 | 15.82 | 3683.95 | 71.86 | 375. | 2. |
| 15 | 15.94 | 3348.57 | 96.86 | 412. | 2. | 16 | 16.13 | 3039.51 | 126.61 | 453. | 2. |
| 17 | 16.35 | 2766.75 | 159.91 | 494. | 2. | 18 | 16.58 | 2534.21 | 195.26 | 533. | 2. |
| 19 | 16.82 | 2330.58 | 230.09 | 568. | 2. | 20 | 17.07 | 2153.29 | 261.96 | 596. | 2. |
| 21 | 17.32 | 1982.43 | 287.66 | 615. | 2. | 22 | 17.58 | 1829.63 | 304.77 | 623. | 2. |
| 23 | 17.85 | 1669.78 | 319.76 | 620. | 2. | 24 | 18.17 | 1537.81 | 304.51 | 604. | 2. |
| 25 | 18.51 | 1401.70 | 285.58 | 575. | 2. | 26 | 18.92 | 1317.81 | 255.14 | 535. | 2. |
| 27 | 19.39 | 1250.19 | 215.65 | 483. | 2. | 28 | 20.00 | 1265.38 | 170.69 | 421. | 2. |
| 29 | 20.77 | 1474.59 | 124.91 | 353. | 2. | 30 | 21.75 | 1337.06 | 94.45 | 281. | 1. |
| 31 | 22.89 | 1988.93 | 53.92 | 211. | 1. | 32 | 24.70 | 2508.80 | 26.47 | 146. | 1. |
| 33 | 27.20 | 3423.55 | 11.17 | 95. | 1. | 34 | 28.37 | 4719.82 | 4.43 | 64. | 1. |
| 35 | 15.00 | 6482.93 | 0.00 | 63. | 1. | | | | | | |

I = 4

| J | P | U BAR | W BAR | RE | CODE | J | P | U BAR | W BAR | RE | CODE |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 15.00 | 1494.97 | 0.00 | 1225. | 2. | 2 | 15.11 | 1674.39 | 100.45 | 1041. | 2. |
| 3 | 15.24 | 1929.52 | 160.95 | 877. | 2. | 4 | 15.40 | 2224.62 | 190.02 | 732. | 2. |
| 5 | 15.57 | 2568.45 | 196.02 | 609. | 2. | 6 | 15.76 | 2959.73 | 186.49 | 508. | 2. |
| 7 | 15.93 | 3393.09 | 167.75 | 429. | 2. | 8 | 16.03 | 3797.98 | 144.61 | 371. | 2. |
| 9 | 16.02 | 4154.83 | 139.26 | 333. | 1. | 10 | 15.90 | 4394.04 | 115.43 | 313. | 1. |
| 11 | 15.71 | 4465.58 | 99.22 | 310. | 1. | 12 | 15.54 | 4377.74 | 92.76 | 321. | 1. |
| 13 | 15.43 | 4159.71 | 99.24 | 343. | 1. | 14 | 15.41 | 3844.88 | 104.80 | 375. | 2. |
| 15 | 15.49 | 3524.36 | 145.09 | 412. | 2. | 16 | 15.63 | 3216.48 | 207.83 | 453. | 2. |
| 17 | 15.81 | 2945.26 | 242.63 | 494. | 2. | 18 | 16.01 | 2714.67 | 396.81 | 533. | 2. |
| 19 | 16.22 | 2513.34 | 514.62 | 568. | 2. | 20 | 16.44 | 2337.91 | 639.09 | 596. | 2. |
| 21 | 16.67 | 2167.35 | 759.85 | 615. | 2. | 22 | 16.91 | 2012.81 | 868.55 | 623. | 2. |
| 23 | 17.16 | 1847.41 | 952.33 | 620. | 2. | 24 | 17.45 | 1706.71 | 1006.00 | 604. | 2. |
| 25 | 17.77 | 1556.68 | 1017.24 | 575. | 2. | 26 | 18.15 | 1455.88 | 988.81 | 535. | 2. |
| 27 | 18.60 | 1366.79 | 913.02 | 483. | 2. | 28 | 19.19 | 1359.40 | 803.29 | 421. | 2. |
| 29 | 19.93 | 1546.52 | 660.78 | 353. | 2. | 30 | 20.89 | 1388.76 | 571.44 | 281. | 1. |
| 31 | 22.01 | 1934.26 | 374.60 | 211. | 1. | 32 | 23.81 | 2515.52 | 222.44 | 146. | 1. |
| 33 | 26.36 | 3407.15 | 118.16 | 95. | 1. | 34 | 27.59 | 4662.00 | 59.46 | 64. | 1. |
| 35 | 15.00 | 6345.87 | 0.00 | 63. | 1. | | | | | | |

I = 5

| J | P | U BAR | W BAR | RE | CODE | J | P | U BAR | W BAR | RE | CODE |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 15.00 | 3917.01 | 0.00 | 1225. | 2. | 2 | 15.00 | 3919.87 | 283.59 | 1041. | 2. |
| 3 | 15.00 | 3922.44 | 451.87 | 877. | 2. | 4 | 15.00 | 3924.70 | 530.28 | 732. | 2. |
| 5 | 15.00 | 3926.62 | 542.06 | 609. | 2. | 6 | 15.00 | 3928.20 | 510.87 | 508. | 2. |
| 7 | 15.00 | 3929.44 | 451.37 | 429. | 2. | 8 | 15.00 | 3930.36 | 376.82 | 371. | 2. |
| 9 | 15.00 | 3930.96 | 344.33 | 333. | 1. | 10 | 15.00 | 3931.29 | 262.40 | 313. | 1. |
| 11 | 15.00 | 3931.36 | 194.27 | 310. | 1. | 12 | 15.00 | 3931.22 | 143.84 | 321. | 1. |
| 13 | 15.00 | 3930.98 | 119.75 | 343. | 1. | 14 | 15.00 | 3930.45 | 105.90 | 375. | 2. |
| 15 | 15.00 | 3929.96 | 154.07 | 412. | 2. | 16 | 15.00 | 3929.31 | 254.89 | 453. | 2. |
| 17 | 15.00 | 3928.71 | 411.05 | 494. | 2. | 18 | 15.00 | 3928.14 | 618.12 | 533. | 2. |
| 19 | 15.00 | 3927.65 | 867.10 | 568. | 2. | 20 | 15.00 | 3927.27 | 1143.40 | 596. | 2. |
| 21 | 15.00 | 3927.33 | 1428.55 | 615. | 2. | 22 | 15.00 | 3926.96 | 1697.82 | 623. | 2. |
| 23 | 15.00 | 3927.04 | 1927.60 | 620. | 2. | 24 | 15.00 | 3927.40 | 2103.05 | 604. | 2. |
| 25 | 15.00 | 3927.91 | 2199.03 | 575. | 2. | 26 | 15.00 | 3928.62 | 2192.85 | 535. | 2. |
| 27 | 15.00 | 3929.53 | 2082.27 | 483. | 2. | 28 | 15.00 | 3930.55 | 1887.42 | 421. | 2. |

| | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| 29 | 15.00 | 3931.70 | 1598.19 | 353. | 2. | 30 | 15.00 | 3932.90 | 1422.50 | 281. 1. |
| 31 | 15.00 | 3934.09 | 956.59 | 211. | 1. | 32 | 15.00 | 3935.19 | 584.97 | 146. 1. |
| 33 | 15.00 | 3936.08 | 319.59 | 95. | 1. | 34 | 15.00 | 3936.65 | 164.50 | 64. 1. |
| 35 | 15.00 | 3936.78 | 0.00 | 63. | 1. | | | | | |



62500

FOIL 6

I = 1

| J | CLEARANCE | FILM THICK | VISCOSITY | PRESSURE | CODE | J | CLEARANCE | FILM THICK | VISCOSITY | PRESSURE | CODE |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | .14415E-01 | .11568E-01 | .42000E-08 | .15000E+02 | 1 | 2 | .13152E-01 | .10166E-01 | .42000E-08 | .15116E+02 | 0 |
| 3 | .11799E-01 | .88758E-02 | .42000E-08 | .15256E+02 | 0 | 4 | .10579E-01 | .77196E-02 | .42000E-08 | .15423E+02 | 0 |
| 5 | .95071E-02 | .67133E-02 | .42000E-08 | .15617E+02 | 0 | 6 | .85930E-02 | .58661E-02 | .42000E-08 | .15830E+02 | 0 |
| 7 | .78398E-02 | .51812E-02 | .42000E-08 | .16035E+02 | 0 | 8 | .72454E-02 | .46566E-02 | .42000E-08 | .16189E+02 | 0 |
| 9 | .68932E-02 | .42855E-02 | .42000E-08 | .16234E+02 | 0 | 10 | .65023E-02 | .40572E-02 | .42000E-08 | .16182E+02 | 0 |
| 11 | .63285E-02 | .39572E-02 | .42000E-08 | .16076E+02 | 0 | 12 | .62649E-02 | .39686E-02 | .42000E-08 | .15982E+02 | 0 |
| 13 | .62019E-02 | .40720E-02 | .42000E-08 | .15952E+02 | 0 | 14 | .63888E-02 | .42464E-02 | .42000E-08 | .16008E+02 | 0 |
| 15 | .65335E-02 | .44697E-02 | .42000E-08 | .16158E+02 | 0 | 16 | .67036E-02 | .47195E-02 | .42000E-08 | .16362E+02 | 0 |
| 17 | .68770E-02 | .49737E-02 | .42000E-08 | .16594E+02 | 0 | 18 | .70323E-02 | .52108E-02 | .42000E-08 | .16839E+02 | 0 |
| 19 | .71495E-02 | .54108E-02 | .42000E-08 | .17088E+02 | 0 | 20 | .72108E-02 | .55558E-02 | .42000E-08 | .17341E+02 | 0 |
| 21 | .72007E-02 | .56303E-02 | .42000E-08 | .17597E+02 | 0 | 22 | .71074E-02 | .56224E-02 | .42000E-08 | .17867E+02 | 0 |
| 23 | .69226E-02 | .55238E-02 | .42000E-08 | .18150E+02 | 0 | 24 | .66425E-02 | .53307E-02 | .42000E-08 | .18465E+02 | 0 |
| 25 | .62685E-02 | .50445E-02 | .42000E-08 | .18810E+02 | 0 | 26 | .58080E-02 | .46721E-02 | .42000E-08 | .19223E+02 | 0 |
| 27 | .52738E-02 | .42269E-02 | .42000E-08 | .19699E+02 | 0 | 28 | .46865E-02 | .37290E-02 | .42000E-08 | .20315E+02 | 0 |
| 29 | .40737E-02 | .32062E-02 | .42000E-08 | .21082E+02 | 0 | 30 | .34713E-02 | .26943E-02 | .42000E-08 | .22061E+02 | 0 |
| 31 | .29241E-02 | .22379E-02 | .42000E-08 | .23209E+02 | 0 | 32 | .24859E-02 | .18909E-02 | .42000E-08 | .25021E+02 | 0 |
| 33 | .22207E-02 | .17172E-02 | .42000E-08 | .27518E+02 | 0 | 34 | .22029E-02 | .17913E-02 | .42000E-08 | .28639E+02 | 0 |
| 35 | .25183E-02 | .21987E-02 | .42000E-08 | .15000E+02 | 1 | | | | | | |

I = 2

| J | CLEARANCE | FILM THICK | VISCOSITY | PRESSURE | CODE | J | CLEARANCE | FILM THICK | VISCOSITY | PRESSURE | CODE |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | .14615E-01 | .11568E-01 | .42000E-08 | .15000E+02 | 1 | 2 | .13152E-01 | .10166E-01 | .42000E-08 | .15116E+02 | 0 |
| 3 | .11799E-01 | .88758E-02 | .42000E-08 | .15255E+02 | 0 | 4 | .10579E-01 | .77196E-02 | .42000E-08 | .15422E+02 | 0 |
| 5 | .95071E-02 | .67133E-02 | .42000E-08 | .15615E+02 | 0 | 6 | .85930E-02 | .58661E-02 | .42000E-08 | .15826E+02 | 0 |
| 7 | .78394E-02 | .51812E-02 | .42000E-08 | .16030E+02 | 0 | 8 | .72454E-02 | .46566E-02 | .42000E-08 | .16180E+02 | 0 |
| 9 | .68932E-02 | .42855E-02 | .42000E-08 | .16221E+02 | 0 | 10 | .65023E-02 | .40572E-02 | .42000E-08 | .16165E+02 | 0 |
| 11 | .63285E-02 | .39572E-02 | .42000E-08 | .16053E+02 | 0 | 12 | .62649E-02 | .39686E-02 | .42000E-08 | .15953E+02 | 0 |
| 13 | .62019E-02 | .40720E-02 | .42000E-08 | .15919E+02 | 0 | 14 | .63888E-02 | .42464E-02 | .42000E-08 | .15970E+02 | 0 |
| 15 | .65335E-02 | .44697E-02 | .42000E-08 | .16115E+02 | 0 | 16 | .67036E-02 | .47195E-02 | .42000E-08 | .16315E+02 | 0 |
| 17 | .68770E-02 | .49737E-02 | .42000E-08 | .16545E+02 | 0 | 18 | .70323E-02 | .52108E-02 | .42000E-08 | .16787E+02 | 0 |
| 19 | .71495E-02 | .54108E-02 | .42000E-08 | .17035E+02 | 0 | 20 | .72108E-02 | .55558E-02 | .42000E-08 | .17286E+02 | 0 |
| 21 | .72007E-02 | .56303E-02 | .42000E-08 | .17542E+02 | 0 | 22 | .71074E-02 | .56224E-02 | .42000E-08 | .17811E+02 | 0 |
| 23 | .69226E-02 | .55238E-02 | .42000E-08 | .18092E+02 | 0 | 24 | .66425E-02 | .53307E-02 | .42000E-08 | .18407E+02 | 0 |
| 25 | .62686E-02 | .50445E-02 | .42000E-08 | .18751E+02 | 0 | 26 | .58080E-02 | .46721E-02 | .42000E-08 | .19164E+02 | 0 |
| 27 | .52738E-02 | .42269E-02 | .42000E-08 | .19639E+02 | 0 | 28 | .46865E-02 | .37290E-02 | .42000E-08 | .20254E+02 | 0 |
| 29 | .40737E-02 | .32062E-02 | .42000E-08 | .21021E+02 | 0 | 30 | .34713E-02 | .26943E-02 | .42000E-08 | .22000E+02 | 0 |
| 31 | .29241E-02 | .22379E-02 | .42000E-08 | .23148E+02 | 0 | 32 | .24859E-02 | .18909E-02 | .42000E-08 | .24960E+02 | 0 |
| 33 | .22207E-02 | .17172E-02 | .42000E-08 | .27457E+02 | 0 | 34 | .22029E-02 | .17913E-02 | .42000E-08 | .28587E+02 | 0 |
| 35 | .25183E-02 | .21987E-02 | .42000E-08 | .15000E+02 | 1 | | | | | | |

I = 3

| J | CLEARANCE | FILM THICK | VISCOSITY | PRESSURE | CODE | J | CLEARANCE | FILM THICK | VISCOSITY | PRESSURE | CODE |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | .14615E-01 | .11568E-01 | .42000E-08 | .15000E+02 | 1 | 2 | .13152E-01 | .10166E-01 | .42000E-08 | .15115E+02 | 0 |
| 3 | .11799E-01 | .88758E-02 | .42000E-08 | .15252E+02 | 0 | 4 | .10579E-01 | .77196E-02 | .42000E-08 | .15417E+02 | 0 |
| 5 | .95071E-02 | .67133E-02 | .42000E-08 | .15607E+02 | 0 | 6 | .85930E-02 | .58661E-02 | .42000E-08 | .15813E+02 | 0 |
| 7 | .78394E-02 | .51812E-02 | .42000E-08 | .16008E+02 | 0 | 8 | .72454E-02 | .46566E-02 | .42000E-08 | .16146E+02 | 0 |
| 9 | .68932E-02 | .42855E-02 | .42000E-08 | .16170E+02 | 0 | 10 | .65023E-02 | .40572E-02 | .42000E-08 | .16096E+02 | 0 |
| 11 | .63285E-02 | .39572E-02 | .42000E-08 | .15962E+02 | 0 | 12 | .62649E-02 | .39686E-02 | .42000E-08 | .15840E+02 | 0 |
| 13 | .62019E-02 | .40720E-02 | .42000E-08 | .15785E+02 | 0 | 14 | .63888E-02 | .42464E-02 | .42000E-08 | .15816E+02 | 0 |
| 15 | .65335E-02 | .44697E-02 | .42000E-08 | .15942E+02 | 0 | 16 | .67036E-02 | .47195E-02 | .42000E-08 | .16128E+02 | 0 |
| 17 | .68770E-02 | .49737E-02 | .42000E-08 | .16346E+02 | 0 | 18 | .70323E-02 | .52108E-02 | .42000E-08 | .16580E+02 | 0 |
| 19 | .71495E-02 | .54108E-02 | .42000E-08 | .16819E+02 | 0 | 20 | .72108E-02 | .55558E-02 | .42000E-08 | .17065E+02 | 0 |
| 21 | .72007E-02 | .56303E-02 | .42000E-08 | .17315E+02 | 0 | 22 | .71074E-02 | .56224E-02 | .42000E-08 | .17580E+02 | 0 |
| 23 | .69226E-02 | .55238E-02 | .42000E-08 | .17857E+02 | 0 | 24 | .66425E-02 | .53307E-02 | .42000E-08 | .18169E+02 | 0 |
| 25 | .62686E-02 | .50445E-02 | .42000E-08 | .18509E+02 | 0 | 26 | .58080E-02 | .46721E-02 | .42000E-08 | .18919E+02 | 0 |

| | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| [illegible] | | | | | 0 | 28 | .46865E-02 | .37290E-02 | .42000E-08 | .20005E+02 | 0 |
| 29 | .40737E-02 | .32062E-02 | .42000E-08 | .20769E+02 | 0 | 30 | .34713E-02 | .26943E-02 | .42000E-08 | .21746E+02 | 0 |
| 31 | .29241E-02 | .22379E-02 | .42000E-08 | .22893E+02 | 0 | 32 | .24859E-02 | .18909E-02 | .42000E-08 | .24703E+02 | 0 |
| 33 | .22207E-02 | .17172E-02 | .42000E-08 | .27205E+02 | 0 | 34 | .22029E-02 | .17913E-02 | .42000E-08 | .28372E+02 | 0 |
| 35 | .25183E-02 | .21987E-02 | .42000E-08 | .15000E+02 | 1 | | | | | | |

I = 4

| J | CLEARANCE | FILM THICK | VISCOSITY | PRESSURE | CODE | J | CLEARANCE | FILM THICK | VISCOSITY | PRESSURE | CODE |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | .14615E-01 | .11568E-01 | .42000E-08 | .15000E+02 | 1 | 2 | .13152E-01 | .10166E-01 | .42000E-08 | .15109E+02 | 0 |
| 3 | .11799E-01 | .88758E-02 | .42000E-08 | .15240E+02 | 0 | 4 | .10579E-01 | .77196E-02 | .42000E-08 | .15395E+02 | 0 |
| 5 | .95071E-02 | .67133E-02 | .42000E-08 | .15572E+02 | 0 | 6 | .85930E-02 | .58661E-02 | .42000E-08 | .15760E+02 | 0 |
| 7 | .78398E-02 | .51812E-02 | .42000E-08 | .15930E+02 | 0 | 8 | .72454E-02 | .46566E-02 | .42000E-08 | .16033E+02 | 0 |
| 9 | .68032E-02 | .42855E-02 | .42000E-08 | .16016E+02 | 0 | 10 | .65023E-02 | .40572E-02 | .42000E-08 | .15896E+02 | 0 |
| 11 | .63285E-02 | .39572E-02 | .42000E-08 | .15711E+02 | 0 | 12 | .62649E-02 | .39686E-02 | .42000E-08 | .15536E+02 | 0 |
| 13 | .62919E-02 | .40720E-02 | .42000E-08 | .15431E+02 | 0 | 14 | .63888E-02 | .42464E-02 | .42000E-08 | .15410E+02 | 0 |
| 15 | .65335E-02 | .44697E-02 | .42000E-08 | .15486E+02 | 0 | 16 | .67036E-02 | .47195E-02 | .42000E-08 | .15628E+02 | 0 |
| 17 | .69770E-02 | .49737E-02 | .42000E-08 | .15809E+02 | 0 | 18 | .70323E-02 | .52108E-02 | .42000E-08 | .16010E+02 | 0 |
| 19 | .71495E-02 | .54108E-02 | .42000E-08 | .16221E+02 | 0 | 20 | .72108E-02 | .55558E-02 | .42000E-08 | .16440E+02 | 0 |
| 21 | .72007E-02 | .56303E-02 | .42000E-08 | .16665E+02 | 0 | 22 | .71074E-02 | .56224E-02 | .42000E-08 | .16906E+02 | 0 |
| 23 | .69226E-02 | .55238E-02 | .42000E-08 | .17160E+02 | 0 | 24 | .66425E-02 | .53307E-02 | .42000E-08 | .17448E+02 | 0 |
| 25 | .62686E-02 | .50445E-02 | .42000E-08 | .17766E+02 | 0 | 26 | .58080E-02 | .46721E-02 | .42000E-08 | .18152E+02 | 0 |
| 27 | .52738E-02 | .42269E-02 | .42000E-08 | .18602E+02 | 0 | 28 | .46865E-02 | .37290E-02 | .42000E-08 | .19191E+02 | 0 |
| 29 | .40737E-02 | .32062E-02 | .42000E-08 | .19930E+02 | 0 | 30 | .34713E-02 | .26943E-02 | .42000E-08 | .20885E+02 | 0 |
| 31 | .29241E-02 | .22379E-02 | .42000E-08 | .22012E+02 | 0 | 32 | .24859E-02 | .18909E-02 | .42000E-08 | .23805E+02 | 0 |
| 33 | .22207E-02 | .17172E-02 | .42000E-08 | .26304E+02 | 0 | 34 | .22029E-02 | .17913E-02 | .42000E-08 | .27591E+02 | 0 |
| 35 | .25183E-02 | .21987E-02 | .42000E-08 | .15000E+02 | 1 | | | | | | |

I = 5

| J | CLEARANCE | FILM THICK | VISCOSITY | PRESSURE | CODE | J | CLEARANCE | FILM THICK | VISCOSITY | PRESSURE | CODE |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | .14615E-01 | .11568E-01 | .42000E-08 | .15000E+02 | 1 | 2 | .13152E-01 | .10166E-01 | .42000E-08 | .15000E+02 | 1 |
| 3 | .11799E-01 | .88758E-02 | .42000E-08 | .15000E+02 | 1 | 4 | .10579E-01 | .77196E-02 | .42000E-08 | .15000E+02 | 1 |
| 5 | .95071E-02 | .67133E-02 | .42000E-08 | .15000E+02 | 1 | 6 | .85930E-02 | .58661E-02 | .42000E-08 | .15000E+02 | 1 |
| 7 | .78398E-02 | .51812E-02 | .42000E-08 | .15000E+02 | 1 | 8 | .72454E-02 | .46566E-02 | .42000E-08 | .15000E+02 | 1 |
| 9 | .68032E-02 | .42855E-02 | .42000E-08 | .15000E+02 | 1 | 10 | .65023E-02 | .40572E-02 | .42000E-08 | .15000E+02 | 1 |
| 11 | .63285E-02 | .39572E-02 | .42000E-08 | .15000E+02 | 1 | 12 | .62649E-02 | .39686E-02 | .42000E-08 | .15000E+02 | 1 |
| 13 | .62919E-02 | .40720E-02 | .42000E-08 | .15000E+02 | 1 | 14 | .63888E-02 | .42464E-02 | .42000E-08 | .15000E+02 | 1 |
| 15 | .65335E-02 | .44697E-02 | .42000E-08 | .15000E+02 | 1 | 16 | .67036E-02 | .47195E-02 | .42000E-08 | .15000E+02 | 1 |
| 17 | .69770E-02 | .49737E-02 | .42000E-08 | .15000E+02 | 1 | 18 | .70323E-02 | .52108E-02 | .42000E-08 | .15000E+02 | 1 |
| 19 | .71495E-02 | .54108E-02 | .42000E-08 | .15000E+02 | 1 | 20 | .72108E-02 | .55558E-02 | .42000E-08 | .15000E+02 | 1 |
| 21 | .72007E-02 | .56303E-02 | .42000E-08 | .15000E+02 | 1 | 22 | .71074E-02 | .56224E-02 | .42000E-08 | .15000E+02 | 1 |
| 23 | .69226E-02 | .55238E-02 | .42000E-08 | .15000E+02 | 1 | 24 | .66425E-02 | .53307E-02 | .42000E-08 | .15000E+02 | 1 |
| 25 | .62686E-02 | .50445E-02 | .42000E-08 | .15000E+02 | 1 | 26 | .58080E-02 | .46721E-02 | .42000E-08 | .15000E+02 | 1 |
| 27 | .52738E-02 | .42269E-02 | .42000E-08 | .15000E+02 | 1 | 28 | .46865E-02 | .37290E-02 | .42000E-08 | .15000E+02 | 1 |
| 29 | .40737E-02 | .32062E-02 | .42000E-08 | .15000E+02 | 1 | 30 | .34713E-02 | .26943E-02 | .42000E-08 | .15000E+02 | 1 |
| 31 | .29241E-02 | .22379E-02 | .42000E-08 | .15000E+02 | 1 | 32 | .24859E-02 | .18909E-02 | .42000E-08 | .15000E+02 | 1 |
| 33 | .22207E-02 | .17172E-02 | .42000E-08 | .15000E+02 | 1 | 34 | .22029E-02 | .17913E-02 | .42000E-08 | .15000E+02 | 1 |
| 35 | .25183E-02 | .21987E-02 | .42000E-08 | .15000E+02 | 1 | | | | | | |

HYDRODYNAMIC GAS OR LIQUID BEARING PROGRAM

ITERATION FOR VSTAR AT LIMIT FRICTION CALCULATIONS DELETED

* * * \

| | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| [illegible] | | | | | | 18 | 17.01 | 2432.24 | 78.12 | 579. | 2. |
| 19 | 17.24 | 2217.93 | 82.19 | 601. | 2. | 20 | 17.48 | 2046.19 | 95.87 | 617. | 2. |
| 21 | 17.73 | 1901.38 | 101.08 | 625. | 2. | 22 | 18.00 | 1814.74 | 103.08 | 624. | 2. |
| 23 | 18.27 | 1761.57 | 101.57 | 613. | 2. | 24 | 18.57 | 1782.48 | 96.36 | 592. | 2. |
| 25 | 18.84 | 1847.01 | 87.81 | 560. | 2. | 26 | 19.22 | 2001.54 | 76.50 | 519. | 2. |
| 27 | 19.56 | 2219.26 | 63.44 | 470. | 2. | 28 | 19.94 | 2549.67 | 49.80 | 414. | 2. |
| 29 | 20.29 | 3034.88 | 36.79 | 356. | 2. | 30 | 20.57 | 3540.77 | 29.32 | 300. | 1. |
| 31 | 20.58 | 4372.15 | 19.16 | 249. | 1. | 32 | 20.12 | 5238.67 | 12.00 | 210. | 1. |
| 33 | 18.68 | 5956.97 | 7.32 | 191. | 1. | 34 | 16.53 | 6190.75 | 3.83 | 199. | 1. |
| 35 | 15.00 | 6201.33 | 0.00 | 245. | 1. | | | | | | |

I = 3

| J | P | U BAR | W BAR | RE | CODE | J | P | U BAR | W BAR | RE | CODE |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 15.00 | 1424.29 | 0.00 | 1280. | 2. | 2 | 15.10 | 1596.14 | 8.38 | 1126. | 2. |
| 3 | 15.22 | 1423.04 | 15.26 | 983. | 2. | 4 | 15.35 | 2088.97 | 20.69 | 856. | 2. |
| 5 | 15.49 | 2388.63 | 24.97 | 745. | 2. | 6 | 15.64 | 2712.59 | 28.61 | 651. | 2. |
| 7 | 15.78 | 3041.92 | 32.19 | 575. | 2. | 8 | 15.90 | 3351.62 | 36.38 | 517. | 2. |
| 9 | 15.98 | 3610.25 | 41.86 | 476. | 2. | 10 | 16.03 | 3789.13 | 49.41 | 451. | 2. |
| 11 | 16.05 | 3866.57 | 59.76 | 440. | 2. | 12 | 16.06 | 3837.76 | 73.67 | 441. | 2. |
| 13 | 16.09 | 3711.44 | 91.67 | 452. | 2. | 14 | 16.16 | 3513.15 | 114.09 | 472. | 2. |
| 15 | 16.27 | 3267.81 | 149.78 | 496. | 2. | 16 | 16.42 | 3006.90 | 171.11 | 524. | 2. |
| 17 | 16.59 | 2744.15 | 203.82 | 552. | 2. | 18 | 16.79 | 2503.46 | 237.10 | 579. | 2. |
| 19 | 17.01 | 2281.66 | 268.65 | 601. | 2. | 20 | 17.25 | 2102.13 | 295.82 | 617. | 2. |
| 21 | 17.49 | 1949.48 | 316.06 | 625. | 2. | 22 | 17.75 | 1854.81 | 326.86 | 624. | 2. |
| 23 | 18.02 | 1793.60 | 326.69 | 613. | 2. | 24 | 18.32 | 1806.26 | 314.43 | 592. | 2. |
| 25 | 18.62 | 1862.66 | 290.78 | 560. | 2. | 26 | 18.96 | 2008.96 | 256.97 | 519. | 2. |
| 27 | 19.30 | 2218.62 | 216.30 | 470. | 2. | 28 | 19.69 | 2540.75 | 172.12 | 414. | 2. |
| 29 | 20.04 | 3018.67 | 129.04 | 356. | 2. | 30 | 20.32 | 3511.40 | 104.05 | 300. | 1. |
| 31 | 20.35 | 4332.32 | 68.49 | 249. | 1. | 32 | 19.91 | 5183.14 | 43.29 | 210. | 1. |
| 33 | 18.52 | 5882.56 | 26.55 | 191. | 1. | 34 | 16.46 | 6097.77 | 13.84 | 199. | 1. |
| 35 | 15.00 | 6072.34 | 0.00 | 245. | 1. | | | | | | |

I = 4

| J | P | U BAR | W BAR | RE | CODE | J | P | U BAR | W BAR | RE | CODE |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 15.00 | 1576.11 | 0.00 | 1280. | 2. | 2 | 15.09 | 1766.08 | 102.61 | 1126. | 2. |
| 3 | 15.20 | 2000.27 | 171.41 | 983. | 2. | 4 | 15.32 | 2269.64 | 212.00 | 856. | 2. |
| 5 | 15.45 | 2571.43 | 230.52 | 745. | 2. | 6 | 15.57 | 2897.75 | 233.28 | 651. | 2. |
| 7 | 15.69 | 3231.05 | 225.88 | 575. | 2. | 8 | 15.78 | 3546.62 | 213.38 | 517. | 2. |
| 9 | 15.83 | 3813.33 | 199.77 | 476. | 2. | 10 | 15.83 | 4001.64 | 188.67 | 451. | 2. |
| 11 | 15.80 | 4089.27 | 183.10 | 440. | 2. | 12 | 15.75 | 4069.87 | 186.41 | 441. | 2. |
| 13 | 15.73 | 3951.60 | 201.55 | 452. | 2. | 14 | 15.75 | 3759.18 | 231.83 | 472. | 2. |
| 15 | 15.80 | 3517.81 | 279.08 | 496. | 2. | 16 | 15.90 | 3259.18 | 345.08 | 524. | 2. |
| 17 | 16.04 | 2997.12 | 424.02 | 552. | 2. | 18 | 16.20 | 2755.77 | 526.50 | 579. | 2. |
| 19 | 16.38 | 2530.78 | 633.12 | 601. | 2. | 20 | 16.59 | 2345.68 | 743.45 | 617. | 2. |
| 21 | 16.80 | 2182.84 | 844.55 | 625. | 2. | 22 | 17.03 | 2074.12 | 931.70 | 624. | 2. |
| 23 | 17.27 | 1992.45 | 988.99 | 613. | 2. | 24 | 17.54 | 1980.20 | 1016.00 | 592. | 2. |
| 25 | 17.82 | 2005.24 | 998.82 | 560. | 2. | 26 | 18.14 | 2116.76 | 945.69 | 519. | 2. |
| 27 | 18.47 | 2247.09 | 850.14 | 470. | 2. | 28 | 18.84 | 2568.22 | 730.16 | 414. | 2. |
| 29 | 19.19 | 3004.48 | 588.96 | 356. | 2. | 30 | 19.49 | 3443.03 | 511.25 | 300. | 1. |
| 31 | 19.55 | 4211.23 | 354.27 | 249. | 1. | 32 | 19.20 | 4997.60 | 232.31 | 210. | 1. |
| 33 | 18.00 | 5625.20 | 137.48 | 191. | 1. | 34 | 16.21 | 5773.91 | 61.93 | 199. | 1. |
| 35 | 15.00 | 5626.07 | 0.00 | 245. | 1. | | | | | | |

I = 5

| J | P | U BAR | W BAR | RE | CODE | J | P | U BAR | W BAR | RE | CODE |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 15.00 | 3917.77 | 0.00 | 1280. | 2. | 2 | 15.00 | 3920.30 | 280.14 | 1126. | 2. |
| 3 | 15.00 | 3922.64 | 466.89 | 983. | 2. | 4 | 15.00 | 3924.74 | 568.61 | 856. | 2. |
| 5 | 15.00 | 3926.59 | 611.14 | 745. | 2. | 6 | 15.00 | 3928.17 | 608.95 | 651. | 2. |
| 7 | 15.00 | 3929.48 | 576.97 | 575. | 2. | 8 | 15.00 | 3930.50 | 528.19 | 517. | 2. |
| 9 | 15.00 | 3931.27 | 472.51 | 476. | 2. | 10 | 15.00 | 3931.79 | 418.35 | 451. | 2. |
| 11 | 15.00 | 3932.04 | 372.72 | 440. | 2. | 12 | 15.00 | 3932.20 | 343.20 | 441. | 2. |
| 13 | 15.00 | 3932.15 | 337.18 | 452. | 2. | 14 | 15.00 | 3931.98 | 363.20 | 472. | 2. |
| 15 | 15.00 | 3931.73 | 427.37 | 496. | 2. | 16 | 15.00 | 3931.44 | 536.11 | 524. | 2. |
| 17 | 15.00 | 3931.14 | 684.10 | 552. | 2. | 18 | 15.00 | 3930.87 | 883.68 | 579. | 2. |
| 19 | 15.00 | 3930.67 | 1108.00 | 601. | 2. | 20 | 15.00 | 3930.56 | 1355.10 | 617. | 2. |
| 21 | 15.00 | 3930.58 | 1506.47 | 625. | 2. | 22 | 15.00 | 3930.74 | 1819.25 | 624. | 2. |
| 23 | 15.00 | 3931.06 | 1987.26 | 613. | 2. | 24 | 15.00 | 3931.54 | 2100.69 | 592. | 2. |
| 25 | 15.00 | 3932.19 | 2116.46 | 560. | 2. | 26 | 15.00 | 3932.39 | 2055.93 | 519. | 2. |
| 27 | 15.00 | 3933.91 | 1999.02 | 470. | 2. | 28 | 15.00 | 3934.92 | 1662.82 | 414. | 2. |

| | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| [illegible] | [illegible] | [illegible] | [illegible] | 355. | 2. | 30 | 15.00 | 3947.02 | 1212.34 | 300. | 1. |
| 31 | 15.00 | 3947.97 | 850.65 | 249. | 1. | 32 | 15.00 | 3938.73 | 562.58 | 210. | 1. |
| 33 | 15.00 | 3939.19 | 329.92 | 191. | 1. | 34 | 15.00 | 3939.22 | 142.83 | 199. | 1. |
| 35 | 15.00 | 3938.67 | 0.00 | 245. | 1. | | | | | | |



82500

# FOIL 7

I = 1

| J | CLEARANCE | FILM THICK | VISCOSITY | PRESSURE | CODE | J | CLEARANCE | FILM THICK | VISCOSITY | PRESSURE | CODE |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | .13518E-01 | .13199E-01 | .42000E-08 | .15000E+02 | 1 | 2 | .12464E-01 | .12237E-01 | .42000E-08 | .15103E+02 | 0 |
| 3 | .11441E-01 | .11306E-01 | .42000E-08 | .15221E+02 | 0 | 4 | .10477E-01 | .10434E-01 | .42000E-08 | .15355E+02 | 0 |
| 5 | .95921E-02 | .96418E-02 | .42000E-08 | .15502E+02 | 0 | 6 | .88014E-02 | .89435E-02 | .42000E-08 | .15657E+02 | 0 |
| 7 | .81134E-02 | .83477E-02 | .42000E-08 | .15808E+02 | 0 | 8 | .75314E-02 | .78579E-02 | .42000E-08 | .15943E+02 | 0 |
| 9 | .70542E-02 | .74727E-02 | .42000E-08 | .16047E+02 | 0 | 10 | .66766E-02 | .71869E-02 | .42000E-08 | .16117E+02 | 0 |
| 11 | .63899E-02 | .69916E-02 | .42000E-08 | .16162E+02 | 0 | 12 | .61824E-02 | .68753E-02 | .42000E-08 | .16203E+02 | 0 |
| 13 | .60404E-02 | .68241E-02 | .42000E-08 | .16263E+02 | 0 | 14 | .59484E-02 | .68225E-02 | .42000E-08 | .16357E+02 | 0 |
| 15 | .58899E-02 | .68538E-02 | .42000E-08 | .16488E+02 | 0 | 16 | .58478E-02 | .69012E-02 | .42000E-08 | .16655E+02 | 0 |
| 17 | .59053E-02 | .69475E-02 | .42000E-08 | .16847E+02 | 0 | 18 | .57461E-02 | .69765E-02 | .42000E-08 | .17063E+02 | 0 |
| 19 | .56554E-02 | .69733E-02 | .42000E-08 | .17291E+02 | 0 | 20 | .55201E-02 | .69249E-02 | .42000E-08 | .17536E+02 | 0 |
| 21 | .53299E-02 | .68208E-02 | .42000E-08 | .17787E+02 | 0 | 22 | .50771E-02 | .66533E-02 | .42000E-08 | .18058E+02 | 0 |
| 23 | .47581E-02 | .64188E-02 | .42000E-08 | .18332E+02 | 0 | 24 | .43735E-02 | .61177E-02 | .42000E-08 | .18633E+02 | 0 |
| 25 | .39285E-02 | .57554E-02 | .42000E-08 | .18937E+02 | 0 | 26 | .34340E-02 | .53426E-02 | .42000E-08 | .19280E+02 | 0 |
| 27 | .29073E-02 | .48962E-02 | .42000E-08 | .19623E+02 | 0 | 28 | .23708E-02 | .44396E-02 | .42000E-08 | .20006E+02 | 0 |
| 29 | .18563E-02 | .40036E-02 | .42000E-08 | .20355E+02 | 0 | 30 | .14021E-02 | .36267E-02 | .42000E-08 | .20630E+02 | 0 |
| 31 | .10551E-02 | .33559E-02 | .42000E-08 | .20636E+02 | 0 | 32 | .87129E-03 | .32470E-02 | .42000E-08 | .20166E+02 | 0 |
| 33 | .91637E-03 | .33657E-02 | .42000E-08 | .18712E+02 | 0 | 34 | .12661E-02 | .37878E-02 | .42000E-08 | .16549E+02 | 0 |
| 35 | .20071E-02 | .45998E-02 | .42000E-08 | .15000E+02 | 1 | | | | | | |

I = 2

| J | CLEARANCE | FILM THICK | VISCOSITY | PRESSURE | CODE | J | CLEARANCE | FILM THICK | VISCOSITY | PRESSURE | CODE |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | .13518E-01 | .13199E-01 | .42000E-08 | .15000E+02 | 1 | 2 | .12464E-01 | .12237E-01 | .42000E-08 | .15102E+02 | 0 |
| 3 | .11441E-01 | .11306E-01 | .42000E-08 | .15220E+02 | 0 | 4 | .10477E-01 | .10434E-01 | .42000E-08 | .15353E+02 | 0 |
| 5 | .95921E-02 | .96418E-02 | .42000E-08 | .15499E+02 | 0 | 6 | .88014E-02 | .89435E-02 | .42000E-08 | .15653E+02 | 0 |
| 7 | .81134E-02 | .83477E-02 | .42000E-08 | .15802E+02 | 0 | 8 | .75314E-02 | .78579E-02 | .42000E-08 | .15934E+02 | 0 |
| 9 | .70542E-02 | .74727E-02 | .42000E-08 | .16035E+02 | 0 | 10 | .66766E-02 | .71869E-02 | .42000E-08 | .16100E+02 | 0 |
| 11 | .63899E-02 | .69916E-02 | .42000E-08 | .16139E+02 | 0 | 12 | .61824E-02 | .68753E-02 | .42000E-08 | .16175E+02 | 0 |
| 13 | .60404E-02 | .68241E-02 | .42000E-08 | .16229E+02 | 0 | 14 | .59484E-02 | .68225E-02 | .42000E-08 | .16318E+02 | 0 |
| 15 | .58899E-02 | .68538E-02 | .42000E-08 | .16445E+02 | 0 | 16 | .58478E-02 | .69012E-02 | .42000E-08 | .16608E+02 | 0 |
| 17 | .59053E-02 | .69475E-02 | .42000E-08 | .16797E+02 | 0 | 18 | .57461E-02 | .69765E-02 | .42000E-08 | .17010E+02 | 0 |
| 19 | .56554E-02 | .69733E-02 | .42000E-08 | .17236E+02 | 0 | 20 | .55201E-02 | .69249E-02 | .42000E-08 | .17479E+02 | 0 |
| 21 | .53299E-02 | .68208E-02 | .42000E-08 | .17729E+02 | 0 | 22 | .50771E-02 | .66533E-02 | .42000E-08 | .17998E+02 | 0 |
| 23 | .47581E-02 | .64188E-02 | .42000E-08 | .18271E+02 | 0 | 24 | .43735E-02 | .61177E-02 | .42000E-08 | .18572E+02 | 0 |
| 25 | .39285E-02 | .57554E-02 | .42000E-08 | .18876E+02 | 0 | 26 | .34340E-02 | .53426E-02 | .42000E-08 | .19218E+02 | 0 |
| 27 | .29073E-02 | .48962E-02 | .42000E-08 | .19561E+02 | 0 | 28 | .23708E-02 | .44396E-02 | .42000E-08 | .19945E+02 | 0 |
| 29 | .18563E-02 | .40036E-02 | .42000E-08 | .20295E+02 | 0 | 30 | .14021E-02 | .36267E-02 | .42000E-08 | .20571E+02 | 0 |
| 31 | .10551E-02 | .33559E-02 | .42000E-08 | .20581E+02 | 0 | 32 | .87129E-03 | .32470E-02 | .42000E-08 | .20117E+02 | 0 |
| 33 | .91637E-03 | .33657E-02 | .42000E-08 | .18676E+02 | 0 | 34 | .12661E-02 | .37878E-02 | .42000E-08 | .16532E+02 | 0 |
| 35 | .20071E-02 | .45998E-02 | .42000E-08 | .15000E+02 | 1 | | | | | | |

I = 3

| J | CLEARANCE | FILM THICK | VISCOSITY | PRESSURE | CODE | J | CLEARANCE | FILM THICK | VISCOSITY | PRESSURE | CODE |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | .13518E-01 | .13199E-01 | .42000E-08 | .15000E+02 | 1 | 2 | .12464E-01 | .12237E-01 | .42000E-08 | .15101E+02 | 0 |
| 3 | .11441E-01 | .11306E-01 | .42000E-08 | .15217E+02 | 0 | 4 | .10477E-01 | .10434E-01 | .42000E-08 | .15347E+02 | 0 |
| 5 | .95921E-02 | .96418E-02 | .42000E-08 | .15489E+02 | 0 | 6 | .88014E-02 | .89435E-02 | .42000E-08 | .15637E+02 | 0 |
| 7 | .81134E-02 | .83477E-02 | .42000E-08 | .15778E+02 | 0 | 8 | .75314E-02 | .78579E-02 | .42000E-08 | .15899E+02 | 0 |
| 9 | .70542E-02 | .74727E-02 | .42000E-08 | .15985E+02 | 0 | 10 | .66766E-02 | .71869E-02 | .42000E-08 | .16032E+02 | 0 |
| 11 | .63899E-02 | .69916E-02 | .42000E-08 | .16050E+02 | 0 | 12 | .61824E-02 | .68753E-02 | .42000E-08 | .16063E+02 | 0 |
| 13 | .60404E-02 | .68241E-02 | .42000E-08 | .16095E+02 | 0 | 14 | .59484E-02 | .68225E-02 | .42000E-08 | .16163E+02 | 0 |
| 15 | .58899E-02 | .68538E-02 | .42000E-08 | .16271E+02 | 0 | 16 | .58478E-02 | .69012E-02 | .42000E-08 | .16418E+02 | 0 |
| 17 | .59053E-02 | .69475E-02 | .42000E-08 | .16593E+02 | 0 | 18 | .57461E-02 | .69765E-02 | .42000E-08 | .16795E+02 | 0 |
| 19 | .56554E-02 | .69733E-02 | .42000E-08 | .17011E+02 | 0 | 20 | .55201E-02 | .69249E-02 | .42000E-08 | .17247E+02 | 0 |
| 21 | .53299E-02 | .68208E-02 | .42000E-08 | .17489E+02 | 0 | 22 | .50771E-02 | .66533E-02 | .42000E-08 | .17753E+02 | 0 |
| 23 | .47581E-02 | .64188E-02 | .42000E-08 | .18021E+02 | 0 | 24 | .43735E-02 | .61177E-02 | .42000E-08 | .18318E+02 | 0 |
| 25 | .39285E-02 | .57554E-02 | .42000E-08 | .18613E+02 | 0 | 26 | .34340E-02 | .53426E-02 | .42000E-08 | .18960E+02 | 0 |

| | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| 27 | [illegible] | [illegible] | [illegible] | .17502E+02 | 0 | 28 | .23708E-02 | .44396E-02 | .42000E-08 | .19687E+02 | 0 |
| 29 | .18563E-02 | .40036E-02 | .42000E-08 | .20041E+02 | 0 | 30 | .14021E-02 | .36267E-02 | .42000E-08 | .20324E+02 | 0 |
| 31 | .10551E-02 | .33559E-02 | .42000E-08 | .20348E+02 | 0 | 32 | .87129E-03 | .32470E-02 | .42000E-08 | .19912E+02 | 0 |
| 33 | .91637E-03 | .33657E-02 | .42000E-08 | .18524E+02 | 0 | 34 | .12661E-02 | .37878E-02 | .42000E-08 | .16459E+02 | 0 |
| 35 | .20071E-02 | .45998E-02 | .42000E-08 | .15000E+02 | 1 | | | | | | |

I = 4

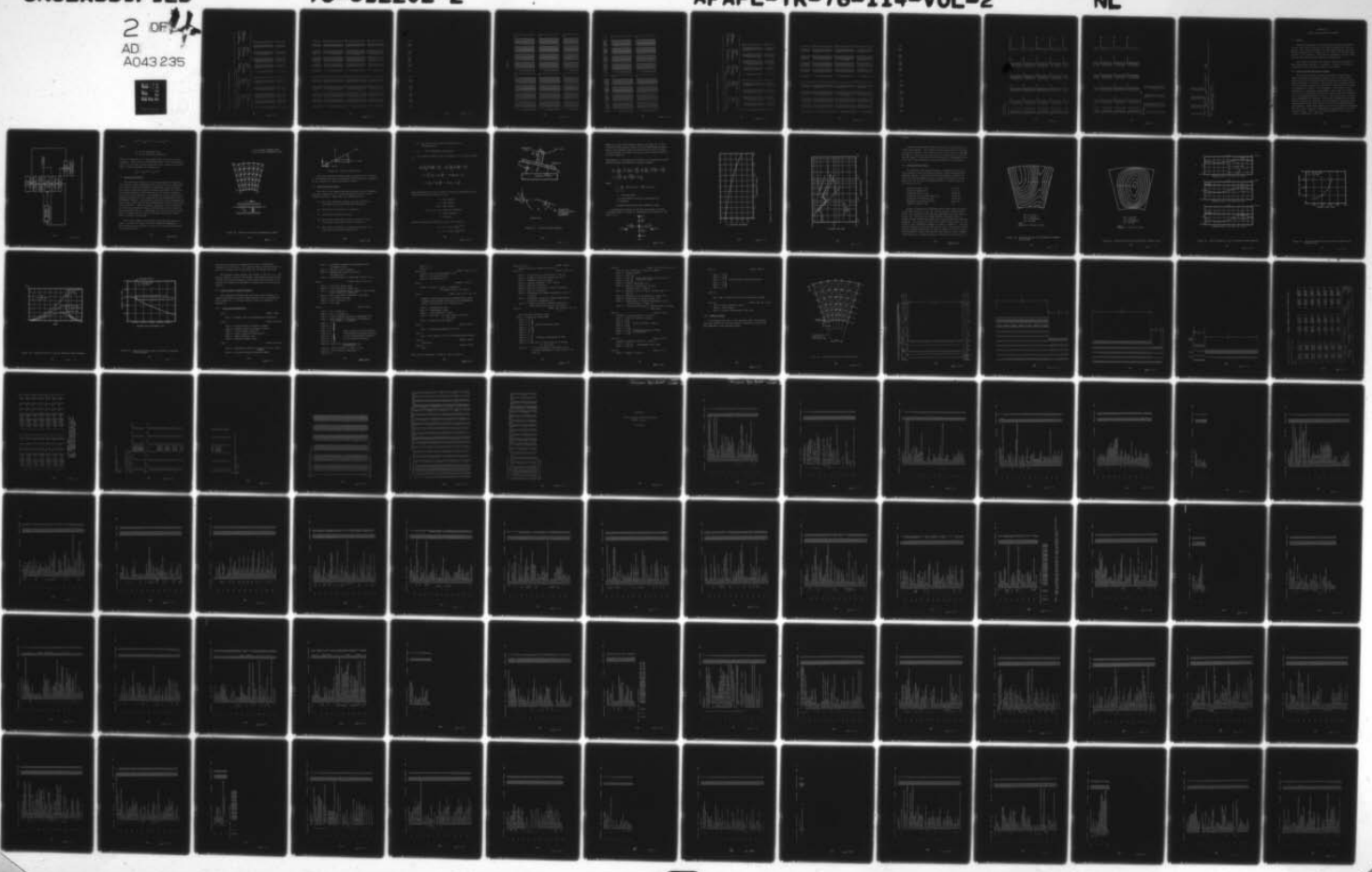
| J | CLEARANCE | FILM THICK | VISCOSITY | PRESSURE | CODE | J | CLEARANCE | FILM THICK | VISCOSITY | PRESSURE | CODE |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | .13514E-01 | .13199E-01 | .42000E-08 | .15000E+02 | 1 | 2 | .12464E-01 | .12237E-01 | .42000E-08 | .15094E+02 | 0 |
| 3 | .11441E-01 | .11306E-01 | .42000E-08 | .15201E+02 | 0 | 4 | .10477E-01 | .10434E-01 | .42000E-08 | .15319E+02 | 0 |
| 5 | .95921E-02 | .96418E-02 | .42000E-08 | .15446E+02 | 0 | 6 | .88014E-02 | .89435E-02 | .42000E-08 | .15575E+02 | 0 |
| 7 | .81134E-02 | .83477E-02 | .42000E-08 | .15692E+02 | 0 | 8 | .75314E-02 | .78579E-02 | .42000E-08 | .15781E+02 | 0 |
| 9 | .70542E-02 | .74727E-02 | .42000E-08 | .15829E+02 | 0 | 10 | .66766E-02 | .71869E-02 | .42000E-08 | .15830E+02 | 0 |
| 11 | .63899E-02 | .69916E-02 | .42000E-08 | .15797E+02 | 0 | 12 | .61824E-02 | .68753E-02 | .42000E-08 | .15755E+02 | 0 |
| 13 | .60404E-02 | .68241E-02 | .42000E-08 | .15731E+02 | 0 | 14 | .59484E-02 | .68225E-02 | .42000E-08 | .15746E+02 | 0 |
| 15 | .58899E-02 | .68538E-02 | .42000E-08 | .15804E+02 | 0 | 16 | .58478E-02 | .69012E-02 | .42000E-08 | .15905E+02 | 0 |
| 17 | .58053E-02 | .69475E-02 | .42000E-08 | .16038E+02 | 0 | 18 | .57461E-02 | .69765E-02 | .42000E-08 | .16202E+02 | 0 |
| 19 | .56554E-02 | .69733E-02 | .42000E-08 | .16382E+02 | 0 | 20 | .55201E-02 | .69249E-02 | .42000E-08 | .16585E+02 | 0 |
| 21 | .53298E-02 | .68208E-02 | .42000E-08 | .16797E+02 | 0 | 22 | .50771E-02 | .66533E-02 | .42000E-08 | .17032E+02 | 0 |
| 23 | .47581E-02 | .64188E-02 | .42000E-08 | .17273E+02 | 0 | 24 | .43735E-02 | .61177E-02 | .42000E-08 | .17545E+02 | 0 |
| 25 | .39285E-02 | .57554E-02 | .42000E-08 | .17822E+02 | 0 | 26 | .34340E-02 | .53426E-02 | .42000E-08 | .18142E+02 | 0 |
| 27 | .29070E-02 | .48962E-02 | .42000E-08 | .18466E+02 | 0 | 28 | .23708E-02 | .44396E-02 | .42000E-08 | .18840E+02 | 0 |
| 29 | .18563E-02 | .40036E-02 | .42000E-08 | .19191E+02 | 0 | 30 | .14021E-02 | .36267E-02 | .42000E-08 | .19488E+02 | 0 |
| 31 | .10551E-02 | .33559E-02 | .42000E-08 | .19547E+02 | 0 | 32 | .87129E-03 | .32470E-02 | .42000E-08 | .19202E+02 | 0 |
| 33 | .91637E-03 | .33657E-02 | .42000E-08 | .17996E+02 | 0 | 34 | .12661E-02 | .37878E-02 | .42000E-08 | .16206E+02 | 0 |
| 35 | .20071E-02 | .45998E-02 | .42000E-08 | .15000E+02 | 1 | | | | | | |

I = 5

| J | CLEARANCE | FILM THICK | VISCOSITY | PRESSURE | CODE | J | CLEARANCE | FILM THICK | VISCOSITY | PRESSURE | CODE |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | .13518E-01 | .13199E-01 | .42000E-08 | .15000E+02 | 1 | 2 | .12464E-01 | .12237E-01 | .42000E-08 | .15000E+02 | 1 |
| 3 | .11441E-01 | .11306E-01 | .42000E-08 | .15000E+02 | 1 | 4 | .10477E-01 | .10434E-01 | .42000E-08 | .15000E+02 | 1 |
| 5 | .95921E-02 | .96418E-02 | .42000E-08 | .15000E+02 | 1 | 6 | .88014E-02 | .89435E-02 | .42000E-08 | .15000E+02 | 1 |
| 7 | .81134E-02 | .83477E-02 | .42000E-08 | .15000E+02 | 1 | 8 | .75314E-02 | .78579E-02 | .42000E-08 | .15000E+02 | 1 |
| 9 | .70542E-02 | .74727E-02 | .42000E-08 | .15000E+02 | 1 | 10 | .66766E-02 | .71869E-02 | .42000E-08 | .15000E+02 | 1 |
| 11 | .63899E-02 | .69916E-02 | .42000E-08 | .15000E+02 | 1 | 12 | .61824E-02 | .68753E-02 | .42000E-08 | .15000E+02 | 1 |
| 13 | .60404E-02 | .68241E-02 | .42000E-08 | .15000E+02 | 1 | 14 | .59484E-02 | .68225E-02 | .42000E-08 | .15000E+02 | 1 |
| 15 | .58899E-02 | .68538E-02 | .42000E-08 | .15000E+02 | 1 | 16 | .58478E-02 | .69012E-02 | .42000E-08 | .15000E+02 | 1 |
| 17 | .58053E-02 | .69475E-02 | .42000E-08 | .15000E+02 | 1 | 18 | .57461E-02 | .69765E-02 | .42000E-08 | .15000E+02 | 1 |
| 19 | .56554E-02 | .69733E-02 | .42000E-08 | .15000E+02 | 1 | 20 | .55201E-02 | .69249E-02 | .42000E-08 | .15000E+02 | 1 |
| 21 | .53298E-02 | .68208E-02 | .42000E-08 | .15000E+02 | 1 | 22 | .50771E-02 | .66533E-02 | .42000E-08 | .15000E+02 | 1 |
| 23 | .47581E-02 | .64188E-02 | .42000E-08 | .15000E+02 | 1 | 24 | .43735E-02 | .61177E-02 | .42000E-08 | .15000E+02 | 1 |
| 25 | .39285E-02 | .57554E-02 | .42000E-08 | .15000E+02 | 1 | 26 | .34340E-02 | .53426E-02 | .42000E-08 | .15000E+02 | 1 |
| 27 | .29070E-02 | .48962E-02 | .42000E-08 | .15000E+02 | 1 | 28 | .23708E-02 | .44396E-02 | .42000E-08 | .15000E+02 | 1 |
| 29 | .18563E-02 | .40036E-02 | .42000E-08 | .15000E+02 | 1 | 30 | .14021E-02 | .36267E-02 | .42000E-08 | .15000E+02 | 1 |
| 31 | .10551E-02 | .33559E-02 | .42000E-08 | .15000E+02 | 1 | 32 | .87129E-03 | .32470E-02 | .42000E-08 | .15000E+02 | 1 |
| 33 | .91637E-03 | .33657E-02 | .42000E-08 | .15000E+02 | 1 | 34 | .12661E-02 | .37878E-02 | .42000E-08 | .15000E+02 | 1 |
| 35 | .20071E-02 | .45998E-02 | .42000E-08 | .15000E+02 | 1 | | | | | | |

AD-A043 235 AIRESEARCH MFG CO OF ARIZONA PHOENIX F/G 13/9
GAS LUBRICATED FOIL BEARING DEVELOPMENT FOR ADVANCED TURBOMACHI--ETC(U)
APR 77 E S ZORZI F33615-73-C-2058
UNCLASSIFIED 76-312202-2 AFAPL-TR-76-114-VOL-2 NL

2 OF 2
AD
A043 235



HYDRODYNAMIC GAS OR LIQUID BEARING PROGRAM

ITERATION FOR VSTAR AT LIMIT FRICTION CALCULATIONS DELETED

* * * \

| | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | 18 | 17.21 | 2022.53 | 132.13 | [illegible] | [illegible] |
| 19 | 17.37 | 1997.23 | 138.91 | 775. | 2. | 20 | 17.55 | 2010.34 | 142.98 | 769. | 2. |
| 21 | 17.72 | 2060.99 | 143.80 | 758. | 2. | 22 | 17.89 | 2164.09 | 141.03 | 739. | 2. |
| 23 | 18.05 | 2317.79 | 134.56 | 713. | 2. | 24 | 18.21 | 2533.98 | 124.67 | 680. | 2. |
| 25 | 18.36 | 2812.32 | 111.87 | 640. | 2. | 26 | 18.49 | 3163.01 | 97.05 | 594. | 2. |
| 27 | 18.57 | 3589.67 | 81.23 | 545. | 2. | 28 | 18.60 | 4099.08 | 65.58 | 494. | 2. |
| 29 | 18.51 | 4688.50 | 51.11 | 446. | 2. | 30 | 18.25 | 5329.08 | 38.60 | 404. | 2. |
| 31 | 17.74 | 5945.05 | 28.36 | 374. | 2. | 32 | 16.98 | 6382.34 | 20.19 | 362. | 2. |
| 33 | 16.10 | 6467.45 | 13.40 | 375. | 2. | 34 | 15.38 | 6081.24 | 7.04 | 422. | 2. |
| 35 | 15.00 | 5109.63 | 0.00 | 512. | 2. | | | | | | |

I = 3

| J | P | U BAR | W BAR | RE | CODE | J | P | U BAR | W BAR | RE | CODE |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 15.00 | 1382.09 | 0.00 | 1461. | 2. | 2 | 15.08 | 1482.42 | 23.07 | 1356. | 2. |
| 3 | 15.17 | 1607.50 | 44.05 | 1253. | 2. | 4 | 15.26 | 1748.67 | 63.03 | 1157. | 2. |
| 5 | 15.36 | 1898.48 | 80.43 | 1069. | 2. | 6 | 15.46 | 2051.74 | 96.87 | 992. | 2. |
| 7 | 15.57 | 2197.03 | 113.11 | 926. | 2. | 8 | 15.69 | 2328.09 | 129.91 | 872. | 2. |
| 9 | 15.80 | 2432.39 | 148.08 | 830. | 2. | 10 | 15.92 | 2507.19 | 168.25 | 798. | 2. |
| 11 | 16.04 | 2543.45 | 191.04 | 777. | 2. | 12 | 16.16 | 2546.44 | 216.63 | 764. | 2. |
| 13 | 16.29 | 2513.15 | 245.20 | 758. | 2. | 14 | 16.42 | 2457.23 | 276.17 | 758. | 2. |
| 15 | 16.55 | 2374.98 | 309.00 | 761. | 2. | 16 | 16.70 | 2299.85 | 342.10 | 767. | 2. |
| 17 | 16.84 | 2214.99 | 374.21 | 772. | 2. | 18 | 17.00 | 2156.85 | 402.80 | 775. | 2. |
| 19 | 17.15 | 2114.35 | 426.23 | 775. | 2. | 20 | 17.32 | 2109.49 | 441.63 | 769. | 2. |
| 21 | 17.48 | 2141.57 | 447.82 | 758. | 2. | 22 | 17.64 | 2225.74 | 442.55 | 739. | 2. |
| 23 | 17.80 | 2360.47 | 426.10 | 713. | 2. | 24 | 17.96 | 2557.75 | 397.93 | 680. | 2. |
| 25 | 18.10 | 2817.46 | 360.38 | 640. | 2. | 26 | 18.23 | 3149.65 | 315.04 | 594. | 2. |
| 27 | 18.32 | 3557.85 | 265.99 | 545. | 2. | 28 | 18.36 | 4048.24 | 216.16 | 494. | 2. |
| 29 | 18.28 | 4617.50 | 169.65 | 446. | 2. | 30 | 18.04 | 5236.00 | 128.67 | 404. | 2. |
| 31 | 17.56 | 5828.04 | 94.87 | 374. | 2. | 32 | 16.84 | 6241.67 | 67.50 | 362. | 2. |
| 33 | 16.01 | 6309.81 | 44.71 | 375. | 2. | 34 | 15.34 | 5916.71 | 23.37 | 422. | 2. |
| 35 | 15.00 | 4951.95 | 0.00 | 512. | 2. | | | | | | |

I = 4

| J | P | U BAR | W BAR | RE | CODE | J | P | U BAR | W BAR | RE | CODE |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 15.00 | 1754.11 | 0.00 | 1461. | 2. | 2 | 15.07 | 1884.02 | 113.60 | 1356. | 2. |
| 3 | 15.14 | 2029.30 | 205.01 | 1253. | 2. | 4 | 15.21 | 2188.14 | 276.46 | 1157. | 2. |
| 5 | 15.29 | 2354.09 | 331.09 | 1069. | 2. | 6 | 15.37 | 2522.32 | 373.03 | 992. | 2. |
| 7 | 15.45 | 2681.47 | 406.16 | 926. | 2. | 8 | 15.53 | 2824.96 | 434.96 | 872. | 2. |
| 9 | 15.61 | 2939.50 | 462.77 | 830. | 2. | 10 | 15.69 | 3021.88 | 493.63 | 798. | 2. |
| 11 | 15.76 | 3061.96 | 529.70 | 777. | 2. | 12 | 15.84 | 3065.04 | 574.23 | 764. | 2. |
| 13 | 15.92 | 3027.00 | 627.58 | 758. | 2. | 14 | 16.00 | 2962.31 | 691.82 | 758. | 2. |
| 15 | 16.08 | 2870.99 | 764.65 | 761. | 2. | 16 | 16.19 | 2772.93 | 846.33 | 767. | 2. |
| 17 | 16.30 | 2668.49 | 931.09 | 772. | 2. | 18 | 16.42 | 2578.82 | 1017.19 | 775. | 2. |
| 19 | 16.54 | 2502.59 | 1095.41 | 775. | 2. | 20 | 16.67 | 2459.70 | 1162.90 | 769. | 2. |
| 21 | 16.80 | 2447.25 | 1208.68 | 758. | 2. | 22 | 16.94 | 2482.53 | 1230.93 | 739. | 2. |
| 23 | 17.07 | 2562.45 | 1220.23 | 713. | 2. | 24 | 17.21 | 2701.35 | 1178.65 | 680. | 2. |
| 25 | 17.34 | 2898.29 | 1102.00 | 640. | 2. | 26 | 17.47 | 3165.19 | 998.24 | 594. | 2. |
| 27 | 17.58 | 3504.97 | 870.22 | 545. | 2. | 28 | 17.61 | 3924.08 | 730.67 | 494. | 2. |
| 29 | 17.56 | 4418.10 | 587.00 | 446. | 2. | 30 | 17.39 | 4956.16 | 451.15 | 404. | 2. |
| 31 | 17.00 | 5464.62 | 327.88 | 374. | 2. | 32 | 16.42 | 5798.48 | 221.24 | 362. | 2. |
| 33 | 15.75 | 5808.77 | 130.00 | 375. | 2. | 34 | 15.23 | 5401.74 | 55.46 | 422. | 2. |
| 35 | 15.00 | 4466.57 | 0.00 | 512. | 2. | | | | | | |

I = 5

| J | P | U BAR | W BAR | RE | CODE | J | P | U BAR | W BAR | RE | CODE |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 15.00 | 3919.66 | 0.00 | 1461. | 2. | 2 | 15.00 | 3921.49 | 269.91 | 1356. | 2. |
| 3 | 15.00 | 3923.25 | 480.61 | 1253. | 2. | 4 | 15.00 | 3924.92 | 636.84 | 1157. | 2. |
| 5 | 15.00 | 3926.45 | 748.66 | 1069. | 2. | 6 | 15.00 | 3927.81 | 825.96 | 992. | 2. |
| 7 | 15.00 | 3929.00 | 879.10 | 926. | 2. | 8 | 15.00 | 3930.01 | 916.00 | 872. | 2. |
| 9 | 15.00 | 3930.83 | 947.31 | 830. | 2. | 10 | 15.00 | 3931.49 | 982.02 | 798. | 2. |
| 11 | 15.00 | 3931.98 | 1024.80 | 777. | 2. | 12 | 15.00 | 3932.34 | 1084.51 | 764. | 2. |
| 13 | 15.00 | 3932.59 | 1141.83 | 758. | 2. | 14 | 15.00 | 3932.74 | 1264.26 | 758. | 2. |
| 15 | 15.00 | 3932.85 | 1386.48 | 761. | 2. | 16 | 15.00 | 3932.92 | 1533.75 | 767. | 2. |
| 17 | 15.00 | 3932.99 | 1692.38 | 772. | 2. | 18 | 15.00 | 3933.09 | 1864.68 | 775. | 2. |
| 19 | 15.00 | 3933.25 | 2027.72 | 775. | 2. | 20 | 15.00 | 3933.43 | 2181.79 | 769. | 2. |
| 21 | 15.00 | 3933.81 | 2297.40 | 758. | 2. | 22 | 15.00 | 3934.25 | 2376.43 | 739. | 2. |
| 23 | 15.00 | 3934.86 | 2350.65 | 713. | 2. | 24 | 15.00 | 3935.47 | 2345.85 | 680. | 2. |
| 25 | 15.00 | 3936.23 | 2225.17 | 640. | 2. | 26 | 15.00 | 3937.39 | 2047.53 | 594. | 2. |
| 27 | 15.00 | 3938.00 | 1808.85 | 545. | 2. | 28 | 15.00 | 3938.93 | 1539.08 | 494. | 2. |



0 0 5 2 9

| | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| [illegible] | [illegible] | [illegible] | [illegible] | 449. | 2. | 30 | 15.00 | 3940.50 | 361.50 | 404. | 2. |
| 31 | 15.00 | 3941.20 | 685.80 | 374. | 2. | 32 | 15.00 | 3941.52 | 458.96 | 362. | 2. |
| 33 | 15.00 | 3941.44 | 254.48 | 375. | 2. | 34 | 15.00 | 3940.83 | 95.64 | 422. | 2. |
| 35 | 15.00 | 3939.55 | 0.00 | 512. | 2. | | | | | | |



62500

FOIL 8

I = 1

| J | CLEARANCE | FILM THICK | VISCOSITY | PRESSURE | CODE | J | CLEARANCE | FILM THICK | VISCOSITY | PRESSURE | CODE |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | .13007E-01 | .15600E-01 | .42000E-08 | .15000E+02 | 1 | 2 | .12143E-01 | .14806E-01 | .42000E-08 | .15084E+02 | 0 |
| 3 | .11275E-01 | .14006E-01 | .42000E-08 | .15176E+02 | 0 | 4 | .10430E-01 | .13228E-01 | .42000E-08 | .15275E+02 | 0 |
| 5 | .96299E-02 | .12492E-01 | .42000E-08 | .15383E+02 | 0 | 6 | .88895E-02 | .11816E-01 | .42000E-08 | .15499E+02 | 0 |
| 7 | .82194E-02 | .11208E-01 | .42000E-08 | .15621E+02 | 0 | 8 | .76252E-02 | .10674E-01 | .42000E-08 | .15749E+02 | 0 |
| 9 | .71081E-02 | .10216E-01 | .42000E-08 | .15882E+02 | 0 | 10 | .66658E-02 | .98311E-02 | .42000E-08 | .16019E+02 | 0 |
| 11 | .62929E-02 | .95137E-02 | .42000E-08 | .16159E+02 | 0 | 12 | .59813E-02 | .92561E-02 | .42000E-08 | .16304E+02 | 0 |
| 13 | .57210E-02 | .90479E-02 | .42000E-08 | .16451E+02 | 0 | 14 | .55003E-02 | .88776E-02 | .42000E-08 | .16605E+02 | 0 |
| 15 | .53067E-02 | .87326E-02 | .42000E-08 | .16761E+02 | 0 | 16 | .51272E-02 | .85998E-02 | .42000E-08 | .16925E+02 | 0 |
| 17 | .49488E-02 | .84663E-02 | .42000E-08 | .17089E+02 | 0 | 18 | .47593E-02 | .83198E-02 | .42000E-08 | .17259E+02 | 0 |
| 19 | .45474E-02 | .81490E-02 | .42000E-08 | .17428E+02 | 0 | 20 | .43037E-02 | .79445E-02 | .42000E-08 | .17603E+02 | 0 |
| 21 | .40210E-02 | .76991E-02 | .42000E-08 | .17773E+02 | 0 | 22 | .36949E-02 | .74083E-02 | .42000E-08 | .17946E+02 | 0 |
| 23 | .33241E-02 | .70709E-02 | .42000E-08 | .18111E+02 | 0 | 24 | .29115E-02 | .66895E-02 | .42000E-08 | .18274E+02 | 0 |
| 25 | .24640E-02 | .62713E-02 | .42000E-08 | .18420E+02 | 0 | 26 | .19935E-02 | .58282E-02 | .42000E-08 | .18549E+02 | 0 |
| 27 | .15176E-02 | .53775E-02 | .42000E-08 | .18634E+02 | 0 | 28 | .10596E-02 | .49427E-02 | .42000E-08 | .18659E+02 | 0 |
| 29 | .64944E-03 | .45536E-02 | .42000E-08 | .18567E+02 | 0 | 30 | .32398E-03 | .42472E-02 | .42000E-08 | .18304E+02 | 0 |
| 31 | .12779E-03 | .40680E-02 | .42000E-08 | .17786E+02 | 0 | 32 | .11354E-03 | .40686E-02 | .42000E-08 | .17011E+02 | 0 |
| 33 | .34252E-03 | .43103E-02 | .42000E-08 | .16115E+02 | 0 | 34 | .88523E-03 | .48637E-02 | .42000E-08 | .15388E+02 | 0 |
| 35 | .18219E-02 | .58088E-02 | .42000E-08 | .15000E+02 | 1 | | | | | | |

I = 2

| J | CLEARANCE | FILM THICK | VISCOSITY | PRESSURE | CODE | J | CLEARANCE | FILM THICK | VISCOSITY | PRESSURE | CODE |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | .13007E-01 | .15600E-01 | .42000E-08 | .15000E+02 | 1 | 2 | .12143E-01 | .14806E-01 | .42000E-08 | .15083E+02 | 0 |
| 3 | .11275E-01 | .14006E-01 | .42000E-08 | .15174E+02 | 0 | 4 | .10430E-01 | .13228E-01 | .42000E-08 | .15272E+02 | 0 |
| 5 | .96299E-02 | .12492E-01 | .42000E-08 | .15378E+02 | 0 | 6 | .88895E-02 | .11816E-01 | .42000E-08 | .15492E+02 | 0 |
| 7 | .82194E-02 | .11208E-01 | .42000E-08 | .15611E+02 | 0 | 8 | .76252E-02 | .10674E-01 | .42000E-08 | .15737E+02 | 0 |
| 9 | .71081E-02 | .10216E-01 | .42000E-08 | .15866E+02 | 0 | 10 | .66658E-02 | .98311E-02 | .42000E-08 | .15999E+02 | 0 |
| 11 | .62929E-02 | .95137E-02 | .42000E-08 | .16135E+02 | 0 | 12 | .59813E-02 | .92561E-02 | .42000E-08 | .16275E+02 | 0 |
| 13 | .57210E-02 | .90479E-02 | .42000E-08 | .16418E+02 | 0 | 14 | .55003E-02 | .88776E-02 | .42000E-08 | .16568E+02 | 0 |
| 15 | .53067E-02 | .87326E-02 | .42000E-08 | .16720E+02 | 0 | 16 | .51272E-02 | .85998E-02 | .42000E-08 | .16880E+02 | 0 |
| 17 | .49488E-02 | .84663E-02 | .42000E-08 | .17040E+02 | 0 | 18 | .47593E-02 | .83198E-02 | .42000E-08 | .17208E+02 | 0 |
| 19 | .45474E-02 | .81490E-02 | .42000E-08 | .17374E+02 | 0 | 20 | .43037E-02 | .79445E-02 | .42000E-08 | .17547E+02 | 0 |
| 21 | .40210E-02 | .76991E-02 | .42000E-08 | .17715E+02 | 0 | 22 | .36949E-02 | .74083E-02 | .42000E-08 | .17887E+02 | 0 |
| 23 | .33241E-02 | .70709E-02 | .42000E-08 | .18051E+02 | 0 | 24 | .29115E-02 | .66895E-02 | .42000E-08 | .18214E+02 | 0 |
| 25 | .24640E-02 | .62713E-02 | .42000E-08 | .18359E+02 | 0 | 26 | .19935E-02 | .58282E-02 | .42000E-08 | .18488E+02 | 0 |
| 27 | .15176E-02 | .53775E-02 | .42000E-08 | .18574E+02 | 0 | 28 | .10596E-02 | .49427E-02 | .42000E-08 | .18601E+02 | 0 |
| 29 | .64944E-03 | .45536E-02 | .42000E-08 | .18512E+02 | 0 | 30 | .32398E-03 | .42472E-02 | .42000E-08 | .18254E+02 | 0 |
| 31 | .12779E-03 | .40680E-02 | .42000E-08 | .17744E+02 | 0 | 32 | .11354E-03 | .40686E-02 | .42000E-08 | .16979E+02 | 0 |
| 33 | .34252E-03 | .43103E-02 | .42000E-08 | .16095E+02 | 0 | 34 | .88523E-03 | .48637E-02 | .42000E-08 | .15380E+02 | 0 |
| 35 | .18219E-02 | .58088E-02 | .42000E-08 | .15000E+02 | 1 | | | | | | |

I = 3

| J | CLEARANCE | FILM THICK | VISCOSITY | PRESSURE | CODE | J | CLEARANCE | FILM THICK | VISCOSITY | PRESSURE | CODE |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | .13007E-01 | .15600E-01 | .42000E-08 | .15000E+02 | 1 | 2 | .12143E-01 | .14806E-01 | .42000E-08 | .15079E+02 | 0 |
| 3 | .11275E-01 | .14006E-01 | .42000E-08 | .15165E+02 | 0 | 4 | .10430E-01 | .13228E-01 | .42000E-08 | .15258E+02 | 0 |
| 5 | .96299E-02 | .12492E-01 | .42000E-08 | .15357E+02 | 0 | 6 | .88895E-02 | .11816E-01 | .42000E-08 | .15462E+02 | 0 |
| 7 | .82194E-02 | .11208E-01 | .42000E-08 | .15572E+02 | 0 | 8 | .76252E-02 | .10674E-01 | .42000E-08 | .15685E+02 | 0 |
| 9 | .71081E-02 | .10216E-01 | .42000E-08 | .15800E+02 | 0 | 10 | .66658E-02 | .98311E-02 | .42000E-08 | .15918E+02 | 0 |
| 11 | .62929E-02 | .95137E-02 | .42000E-08 | .16037E+02 | 0 | 12 | .59813E-02 | .92561E-02 | .42000E-08 | .16160E+02 | 0 |
| 13 | .57210E-02 | .90479E-02 | .42000E-08 | .16285E+02 | 0 | 14 | .55003E-02 | .88776E-02 | .42000E-08 | .16418E+02 | 0 |
| 15 | .53067E-02 | .87326E-02 | .42000E-08 | .16553E+02 | 0 | 16 | .51272E-02 | .85998E-02 | .42000E-08 | .16698E+02 | 0 |
| 17 | .49488E-02 | .84663E-02 | .42000E-08 | .16844E+02 | 0 | 18 | .47593E-02 | .83198E-02 | .42000E-08 | .16999E+02 | 0 |
| 19 | .45474E-02 | .81490E-02 | .42000E-08 | .17155E+02 | 0 | 20 | .43037E-02 | .79445E-02 | .42000E-08 | .17318E+02 | 0 |
| 21 | .40210E-02 | .76991E-02 | .42000E-08 | .17478E+02 | 0 | 22 | .36949E-02 | .74083E-02 | .42000E-08 | .17643E+02 | 0 |
| 23 | .33241E-02 | .70709E-02 | .42000E-08 | .17802E+02 | 0 | 24 | .29115E-02 | .66895E-02 | .42000E-08 | .17961E+02 | 0 |
| 25 | .24640E-02 | .62713E-02 | .42000E-08 | .18104E+02 | 0 | 26 | .19935E-02 | .58282E-02 | .42000E-08 | .18234E+02 | 0 |

| | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| 29 | .64944E-03 | .45536E-02 | .42000E-08 | .14281E+02 | 0 | 30 | .32398E-03 | .42472E-02 | .42000E-08 | .18044E+02 | 0 |
| 31 | .12779E-03 | .40680E-02 | .42000E-08 | .17565E+02 | 0 | 32 | .11354E-03 | .40686E-02 | .42000E-08 | .16843E+02 | 0 |
| 33 | .34252E-03 | .43103E-02 | .42000E-08 | .16011E+02 | 0 | 34 | .88523E-03 | .48637E-02 | .42000E-08 | .15344E+02 | 0 |
| 35 | .19219E-02 | .58088E-02 | .42000E-08 | .15000E+02 | 1 | | | | | | |

I = 4

| I | CLEARANCE | FILM THICK | VISCOSITY | PRESSURE | CODE | J | CLEARANCE | FILM THICK | VISCOSITY | PRESSURE | CODE |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | .13007E-01 | .15600E-01 | .42000E-08 | .15000E+02 | 1 | 2 | .12143E-01 | .14806E-01 | .42000E-08 | .15067E+02 | 0 |
| 3 | .11275E-01 | .14006E-01 | .42000E-08 | .15138E+02 | 0 | 4 | .10430E-01 | .13228E-01 | .42000E-08 | .15213E+02 | 0 |
| 5 | .96299E-02 | .12492E-01 | .42000E-08 | .15291E+02 | 0 | 6 | .88895E-02 | .11816E-01 | .42000E-08 | .15372E+02 | 0 |
| 7 | .82194E-02 | .11208E-01 | .42000E-08 | .15452E+02 | 0 | 8 | .76252E-02 | .10674E-01 | .42000E-08 | .15532E+02 | 0 |
| 9 | .71081E-02 | .10216E-01 | .42000E-08 | .15610E+02 | 0 | 10 | .66658E-02 | .98311E-02 | .42000E-08 | .15686E+02 | 0 |
| 11 | .62929E-02 | .95137E-02 | .42000E-08 | .15761E+02 | 0 | 12 | .59813E-02 | .92561E-02 | .42000E-08 | .15838E+02 | 0 |
| 13 | .57210E-02 | .90479E-02 | .42000E-08 | .15916E+02 | 0 | 14 | .55003E-02 | .88776E-02 | .42000E-08 | .16002E+02 | 0 |
| 15 | .53067E-02 | .87326E-02 | .42000E-08 | .16093E+02 | 0 | 16 | .51272E-02 | .85998E-02 | .42000E-08 | .16193E+02 | 0 |
| 17 | .49488E-02 | .84663E-02 | .42000E-08 | .16299E+02 | 0 | 18 | .47593E-02 | .83198E-02 | .42000E-08 | .16416E+02 | 0 |
| 19 | .45474E-02 | .81490E-02 | .42000E-08 | .16536E+02 | 0 | 20 | .43037E-02 | .79445E-02 | .42000E-08 | .16666E+02 | 0 |
| 21 | .40210E-02 | .76991E-02 | .42000E-08 | .16797E+02 | 0 | 22 | .36949E-02 | .74083E-02 | .42000E-08 | .16937E+02 | 0 |
| 23 | .33241E-02 | .70709E-02 | .42000E-08 | .17072E+02 | 0 | 24 | .29115E-02 | .66895E-02 | .42000E-08 | .17214E+02 | 0 |
| 25 | .24640E-02 | .62713E-02 | .42000E-08 | .17343E+02 | 0 | 26 | .19935E-02 | .58282E-02 | .42000E-08 | .17467E+02 | 0 |
| 27 | .15176E-02 | .53775E-02 | .42000E-08 | .17558E+02 | 0 | 28 | .10596E-02 | .49427E-02 | .42000E-08 | .17607E+02 | 0 |
| 29 | .64944E-03 | .45536E-02 | .42000E-08 | .17564E+02 | 0 | 30 | .32398E-03 | .42472E-02 | .42000E-08 | .17386E+02 | 0 |
| 31 | .12779E-03 | .40680E-02 | .42000E-08 | .17002E+02 | 0 | 32 | .11354E-03 | .40686E-02 | .42000E-08 | .16417E+02 | 0 |
| 33 | .34252E-03 | .43103E-02 | .42000E-08 | .15748E+02 | 0 | 34 | .88523E-03 | .48637E-02 | .42000E-08 | .15235E+02 | 0 |
| 35 | .19219E-02 | .58088E-02 | .42000E-08 | .15000E+02 | 1 | | | | | | |

I = 5

| I | CLEARANCE | FILM THICK | VISCOSITY | PRESSURE | CODE | J | CLEARANCE | FILM THICK | VISCOSITY | PRESSURE | CODE |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | .13007E-01 | .15600E-01 | .42000E-08 | .15000E+02 | 1 | 2 | .12143E-01 | .14806E-01 | .42000E-08 | .15000E+02 | 1 |
| 3 | .11275E-01 | .14006E-01 | .42000E-08 | .15000E+02 | 1 | 4 | .10430E-01 | .13228E-01 | .42000E-08 | .15000E+02 | 1 |
| 5 | .96299E-02 | .12492E-01 | .42000E-08 | .15000E+02 | 1 | 6 | .88895E-02 | .11816E-01 | .42000E-08 | .15000E+02 | 1 |
| 7 | .82194E-02 | .11208E-01 | .42000E-08 | .15000E+02 | 1 | 8 | .76252E-02 | .10674E-01 | .42000E-08 | .15000E+02 | 1 |
| 9 | .71081E-02 | .10216E-01 | .42000E-08 | .15000E+02 | 1 | 10 | .66658E-02 | .98311E-02 | .42000E-08 | .15000E+02 | 1 |
| 11 | .62929E-02 | .95137E-02 | .42000E-08 | .15000E+02 | 1 | 12 | .59813E-02 | .92561E-02 | .42000E-08 | .15000E+02 | 1 |
| 13 | .57210E-02 | .90479E-02 | .42000E-08 | .15000E+02 | 1 | 14 | .55003E-02 | .88776E-02 | .42000E-08 | .15000E+02 | 1 |
| 15 | .53067E-02 | .87326E-02 | .42000E-08 | .15000E+02 | 1 | 16 | .51272E-02 | .85998E-02 | .42000E-08 | .15000E+02 | 1 |
| 17 | .49488E-02 | .84663E-02 | .42000E-08 | .15000E+02 | 1 | 18 | .47593E-02 | .83198E-02 | .42000E-08 | .15000E+02 | 1 |
| 19 | .45474E-02 | .81490E-02 | .42000E-08 | .15000E+02 | 1 | 20 | .43037E-02 | .79445E-02 | .42000E-08 | .15000E+02 | 1 |
| 21 | .40210E-02 | .76991E-02 | .42000E-08 | .15000E+02 | 1 | 22 | .36949E-02 | .74083E-02 | .42000E-08 | .15000E+02 | 1 |
| 23 | .33241E-02 | .70709E-02 | .42000E-08 | .15000E+02 | 1 | 24 | .29115E-02 | .66895E-02 | .42000E-08 | .15000E+02 | 1 |
| 25 | .24640E-02 | .62713E-02 | .42000E-08 | .15000E+02 | 1 | 26 | .19935E-02 | .58282E-02 | .42000E-08 | .15000E+02 | 1 |
| 27 | .15176E-02 | .53775E-02 | .42000E-08 | .15000E+02 | 1 | 28 | .10596E-02 | .49427E-02 | .42000E-08 | .15000E+02 | 1 |
| 29 | .64944E-03 | .45536E-02 | .42000E-08 | .15000E+02 | 1 | 30 | .32398E-03 | .42472E-02 | .42000E-08 | .15000E+02 | 1 |
| 31 | .12779E-03 | .40680E-02 | .42000E-08 | .15000E+02 | 1 | 32 | .11354E-03 | .40686E-02 | .42000E-08 | .15000E+02 | 1 |
| 33 | .34252E-03 | .43103E-02 | .42000E-08 | .15000E+02 | 1 | 34 | .88523E-03 | .48637E-02 | .42000E-08 | .15000E+02 | 1 |
| 35 | .19219E-02 | .58088E-02 | .42000E-08 | .15000E+02 | 1 | | | | | | |



82500

HYDRODYNAMIC GAS OR LIQUID BEARING PROGRAM

ITERATION FOR VSTAR AT LIMIT FRICTION CALCULATIONS DELETED

SYMMETRY ROUTINE USED -- VALUES PRINTED ARE FOR WHOLE BEARING

| ECCENTRICITY RATIO (---) | RESULTANT FORCE (LBS) | ATTITUDE ANGLE (DEGREES) | JOURNAL FRIC. MOMENT (IN-LBS) | BEARING FRIC. MOMENT (IN-LBS) |
|---|---|---|---|---|
| .0040 | 167.73 | 22.86 | .258 | .095 |

| FRICTION (HP) | FRICTION (WATTS) | LUBRICANT FLOW 1 (CU.IN./SEC.) | LUBRICANT FLOW 2 (CU.IN./SEC.) | LUBRICANT FLOW 3 (CU.IN./SEC.) |
|---|---|---|---|---|
| .13507 | 100.72 | 2.535 | 1.388 | 4.270 |

| FX--FORCE COMPONENT (LBS) | FY--FORCE COMPONENT (LBS) | MX--MOMENT (IN-LBS) | MY--MOMENT (IN-LBS) |
|---|---|---|---|
| 154.56 | 65.15 | | |

I = 1

| J | P | U BAR | W BAR | RE | CODE | J | P | U BAR | W BAR | RE | CODE |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 15.00 | 555.44 | 0.00 | 1728. | 2. | 2 | 15.08 | 572.17 | -2.89 | 1640. | 2. |
| 3 | 15.17 | 613.68 | -5.61 | 1552. | 2. | 4 | 15.26 | 665.26 | -8.11 | 1467. | 2. |
| 5 | 15.36 | 722.32 | -10.50 | 1386. | 2. | 6 | 15.47 | 786.54 | -12.68 | 1311. | 2. |
| 7 | 15.58 | 852.22 | -14.87 | 1244. | 2. | 8 | 15.71 | 921.62 | -16.91 | 1185. | 2. |
| 9 | 15.84 | 988.52 | -19.07 | 1134. | 2. | 10 | 15.97 | 1056.68 | -21.12 | 1092. | 2. |
| 11 | 16.12 | 1120.29 | -23.36 | 1057. | 2. | 12 | 16.26 | 1185.34 | -25.48 | 1028. | 2. |
| 13 | 16.41 | 1247.28 | -27.80 | 1005. | 2. | 14 | 16.56 | 1314.37 | -29.90 | 986. | 2. |
| 15 | 16.71 | 1383.63 | -32.10 | 970. | 2. | 16 | 16.86 | 1464.89 | -33.91 | 956. | 2. |
| 17 | 17.01 | 1556.49 | -35.63 | 941. | 2. | 18 | 17.16 | 1668.76 | -36.73 | 925. | 2. |
| 19 | 17.30 | 1801.04 | -37.50 | 906. | 2. | 20 | 17.45 | 1963.09 | -37.44 | 883. | 2. |
| 21 | 17.58 | 2155.12 | -36.87 | 856. | 2. | 22 | 17.71 | 2385.74 | -35.37 | 824. | 2. |
| 23 | 17.82 | 2656.43 | -33.33 | 786. | 2. | 24 | 17.93 | 2974.77 | -30.49 | 744. | 2. |
| 25 | 18.00 | 3344.15 | -27.29 | 698. | 2. | 26 | 18.05 | 3770.84 | -23.63 | 649. | 2. |
| 27 | 18.04 | 4257.83 | -19.97 | 599. | 2. | 28 | 17.96 | 4801.95 | -16.32 | 550. | 2. |
| 29 | 17.77 | 5386.49 | -13.03 | 507. | 2. | 30 | 17.43 | 5961.66 | -10.09 | 473. | 2. |
| 31 | 16.93 | 6438.40 | -7.64 | 453. | 2. | 32 | 16.31 | 6683.65 | -5.54 | 453. | 2. |
| 33 | 15.70 | 6581.87 | -3.71 | 480. | 2. | 34 | 15.24 | 6086.96 | -1.94 | 542. | 2. |
| 35 | 15.00 | 5093.32 | 0.00 | 646. | 2. | | | | | | |

I = 2

| J | P | U BAR | W BAR | RE | CODE | J | P | U BAR | W BAR | RE | CODE |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 15.00 | 608.70 | 0.00 | 1728. | 2. | 2 | 15.08 | 628.71 | 13.45 | 1640. | 2. |
| 3 | 15.16 | 673.03 | 26.08 | 1552. | 2. | 4 | 15.25 | 727.39 | 37.93 | 1467. | 2. |
| 5 | 15.35 | 787.34 | 49.11 | 1386. | 2. | 6 | 15.46 | 854.11 | 59.80 | 1311. | 2. |
| 7 | 15.57 | 922.10 | 70.17 | 1244. | 2. | 8 | 15.69 | 993.11 | 80.42 | 1185. | 2. |
| 9 | 15.82 | 1061.03 | 90.70 | 1134. | 2. | 10 | 15.95 | 1129.20 | 101.12 | 1092. | 2. |
| 11 | 16.09 | 1192.63 | 111.71 | 1057. | 2. | 12 | 16.23 | 1255.14 | 122.43 | 1028. | 2. |
| 13 | 16.38 | 1314.32 | 133.11 | 1005. | 2. | 14 | 16.53 | 1377.62 | 143.53 | 986. | 2. |
| 15 | 16.67 | 1442.37 | 153.29 | 970. | 2. | 16 | 16.82 | 1519.36 | 162.00 | 956. | 2. |



0 0 5 6 3

| | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | 2. | 18 | 17.11 | 1710.14 | 174.08 | 925. | 2. |
| 19 | 17.25 | 1838.25 | 176.41 | 906. | 2. | 20 | 17.39 | 1991.76 | 175.72 | 883. | 2. |
| 21 | 17.52 | 2177.28 | 171.66 | 856. | 2. | 22 | 17.65 | 2401.45 | 164.24 | 824. | 2. |
| 23 | 17.77 | 2665.84 | 153.53 | 786. | 2. | 24 | 17.87 | 2978.05 | 140.05 | 744. | 2. |
| 25 | 17.94 | 3361.46 | 124.37 | 698. | 2. | 26 | 17.99 | 3762.31 | 107.45 | 649. | 2. |
| 27 | 17.99 | 4243.45 | 90.17 | 599. | 2. | 28 | 17.91 | 4781.62 | 73.58 | 550. | 2. |
| 29 | 17.72 | 5359.91 | 58.41 | 507. | 2. | 30 | 17.39 | 5928.62 | 45.24 | 473. | 2. |
| 31 | 16.89 | 6398.87 | 34.14 | 453. | 2. | 32 | 16.29 | 6638.62 | 24.83 | 453. | 2. |
| 33 | 15.69 | 6533.54 | 16.63 | 480. | 2. | 34 | 15.24 | 6039.01 | 8.71 | 542. | 2. |
| 35 | 15.00 | 5049.45 | 0.00 | 646. | 2. | | | | | | |

I = 3

| J | P | U BAR | W BAR | RE | CODE | J | P | U BAR | W BAR | RE | CODE |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 15.00 | 826.98 | 0.00 | 1728. | 2. | 2 | 15.07 | 860.32 | 42.90 | 1640. | 2. |
| 3 | 15.15 | 915.46 | 82.98 | 1552. | 2. | 4 | 15.23 | 980.96 | 120.12 | 1467. | 2. |
| 5 | 15.33 | 1051.65 | 154.71 | 1386. | 2. | 6 | 15.42 | 1128.43 | 187.13 | 1311. | 2. |
| 7 | 15.53 | 1204.83 | 218.20 | 1244. | 2. | 8 | 15.63 | 1282.21 | 248.38 | 1185. | 2. |
| 9 | 15.75 | 1353.67 | 278.50 | 1134. | 2. | 10 | 15.87 | 1422.20 | 308.72 | 1092. | 2. |
| 11 | 15.99 | 1481.73 | 339.65 | 1057. | 2. | 12 | 16.12 | 1537.86 | 370.86 | 1028. | 2. |
| 13 | 16.25 | 1586.30 | 402.49 | 1005. | 2. | 14 | 16.38 | 1635.37 | 433.37 | 986. | 2. |
| 15 | 16.51 | 1682.74 | 463.10 | 970. | 2. | 16 | 16.65 | 1738.61 | 489.72 | 956. | 2. |
| 17 | 16.78 | 1802.19 | 512.46 | 941. | 2. | 18 | 16.92 | 1884.21 | 528.84 | 925. | 2. |
| 19 | 17.05 | 1984.89 | 538.13 | 906. | 2. | 20 | 17.18 | 2114.36 | 537.95 | 883. | 2. |
| 21 | 17.30 | 2273.55 | 528.27 | 856. | 2. | 22 | 17.42 | 2471.33 | 507.62 | 824. | 2. |
| 23 | 17.53 | 2709.67 | 477.29 | 786. | 2. | 24 | 17.63 | 2996.19 | 437.36 | 744. | 2. |
| 25 | 17.71 | 3334.42 | 390.68 | 698. | 2. | 26 | 17.75 | 3730.33 | 338.96 | 649. | 2. |
| 27 | 17.76 | 4186.51 | 285.95 | 599. | 2. | 28 | 17.69 | 4699.13 | 234.05 | 550. | 2. |
| 29 | 17.51 | 5258.85 | 186.48 | 507. | 2. | 30 | 17.21 | 5791.95 | 144.54 | 473. | 2. |
| 31 | 16.75 | 6234.94 | 109.11 | 453. | 2. | 32 | 16.18 | 6451.47 | 79.10 | 453. | 2. |
| 33 | 15.62 | 6332.94 | 52.79 | 480. | 2. | 34 | 15.21 | 5840.05 | 27.50 | 542. | 2. |
| 35 | 15.00 | 4868.18 | 0.00 | 646. | 2. | | | | | | |

I = 4

| J | P | U BAR | W BAR | RE | CODE | J | P | U BAR | W BAR | RE | CODE |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 15.00 | 1477.28 | 0.00 | 1728. | 2. | 2 | 15.06 | 1545.37 | 147.72 | 1640. | 2. |
| 3 | 15.12 | 1625.92 | 277.15 | 1552. | 2. | 4 | 15.18 | 1714.36 | 389.22 | 1467. | 2. |
| 5 | 15.25 | 1804.82 | 485.55 | 1386. | 2. | 6 | 15.32 | 1898.60 | 569.30 | 1311. | 2. |
| 7 | 15.39 | 1987.72 | 642.98 | 1244. | 2. | 8 | 15.47 | 2073.78 | 710.43 | 1185. | 2. |
| 9 | 15.55 | 2147.84 | 773.76 | 1134. | 2. | 10 | 15.63 | 2213.49 | 836.47 | 1092. | 2. |
| 11 | 15.72 | 2282.55 | 899.40 | 1057. | 2. | 12 | 15.80 | 2301.94 | 965.05 | 1028. | 2. |
| 13 | 15.89 | 2325.44 | 1032.35 | 1005. | 2. | 14 | 15.98 | 2343.50 | 1102.41 | 986. | 2. |
| 15 | 16.07 | 2352.02 | 1171.82 | 970. | 2. | 16 | 16.17 | 2363.80 | 1240.16 | 956. | 2. |
| 17 | 16.27 | 2376.32 | 1301.73 | 941. | 2. | 18 | 16.37 | 2403.03 | 1354.87 | 925. | 2. |
| 19 | 16.46 | 2442.51 | 1392.42 | 906. | 2. | 20 | 16.56 | 2507.42 | 1412.59 | 883. | 2. |
| 21 | 16.66 | 2597.36 | 1408.45 | 856. | 2. | 22 | 16.76 | 2723.42 | 1379.82 | 824. | 2. |
| 23 | 16.85 | 2886.68 | 1322.32 | 786. | 2. | 24 | 16.94 | 3096.47 | 1239.14 | 744. | 2. |
| 25 | 17.01 | 3355.78 | 1130.38 | 698. | 2. | 26 | 17.06 | 3671.27 | 1003.30 | 649. | 2. |
| 27 | 17.07 | 4045.05 | 862.53 | 599. | 2. | 28 | 17.03 | 4472.66 | 717.73 | 550. | 2. |
| 29 | 16.90 | 4936.81 | 575.12 | 507. | 2. | 30 | 16.67 | 5388.30 | 442.38 | 473. | 2. |
| 31 | 16.30 | 5746.14 | 322.47 | 453. | 2. | 32 | 15.86 | 5892.75 | 217.69 | 453. | 2. |
| 33 | 15.43 | 5734.19 | 127.87 | 480. | 2. | 34 | 15.13 | 5255.18 | 54.55 | 542. | 2. |
| 35 | 15.00 | 4344.58 | 0.00 | 646. | 2. | | | | | | |

I = 5

| J | P | U BAR | W BAR | RE | CODE | J | P | U BAR | W BAR | RE | CODE |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 15.00 | 3920.55 | 0.00 | 1728. | 2. | 2 | 15.00 | 3922.04 | 314.80 | 1640. | 2. |
| 3 | 15.00 | 3923.54 | 583.41 | 1552. | 2. | 4 | 15.00 | 3925.00 | 809.08 | 1467. | 2. |
| 5 | 15.00 | 3926.38 | 995.68 | 1386. | 2. | 6 | 15.00 | 3927.66 | 1151.42 | 1311. | 2. |
| 7 | 15.00 | 3928.82 | 1281.51 | 1244. | 2. | 8 | 15.00 | 3929.85 | 1395.94 | 1185. | 2. |
| 9 | 15.00 | 3930.74 | 1498.47 | 1134. | 2. | 10 | 15.00 | 3931.50 | 1599.01 | 1092. | 2. |
| 11 | 15.00 | 3932.15 | 1698.09 | 1057. | 2. | 12 | 15.00 | 3932.69 | 1804.49 | 1028. | 2. |
| 13 | 15.00 | 3933.14 | 1914.29 | 1005. | 2. | 14 | 15.00 | 3933.52 | 2034.23 | 986. | 2. |
| 15 | 15.00 | 3933.85 | 2155.04 | 970. | 2. | 16 | 15.00 | 3934.16 | 2281.50 | 956. | 2. |
| 17 | 15.00 | 3934.47 | 2389.22 | 941. | 2. | 18 | 15.00 | 3934.80 | 2508.22 | 925. | 2. |
| 19 | 15.00 | 3935.14 | 2591.47 | 906. | 2. | 20 | 15.00 | 3935.59 | 2650.57 | 883. | 2. |
| 21 | 15.00 | 3936.07 | 2664.13 | 856. | 2. | 22 | 15.00 | 3936.64 | 2647.07 | 824. | 2. |
| 23 | 15.00 | 3937.28 | 2551.74 | 786. | 2. | 24 | 15.00 | 3937.99 | 2418.60 | 744. | 2. |
| 25 | 15.00 | 3938.76 | 2228.79 | 698. | 2. | 26 | 15.00 | 3939.58 | 2000.05 | 649. | 2. |
| 27 | 15.00 | 3940.40 | 1734.27 | 599. | 2. | 28 | 15.00 | 3941.19 | 1454.03 | 550. | 2. |

| | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 29 | 15.00 | 3941.50 | 1167.72 | 507. | 2. | 30 | 15.00 | 3942.46 | 894.82 | 473. | 2. |
| 31 | 15.00 | 3942.80 | 641.03 | 453. | 2. | 32 | 15.00 | 3942.83 | 416.70 | 453. | 2. |
| 33 | 15.00 | 3942.43 | 226.04 | 480. | 2. | 34 | 15.00 | 3941.49 | 81.71 | 542. | 2. |
| 35 | 15.00 | 3939.87 | 0.00 | 646. | 2. | | | | | | |

0 0 5 2 3

8 FOIL TEST CASE

SYSTEM DESCRIPTION

ECCENTRICITY = .0040

| FOIL = 1 | RINITIAL | RADIAL DEFL | RFINAL | RADIAL FORCE | OVERLAP PAIRS | B.C. |
|---|---|---|---|---|---|---|
| | | | | | 0 | B |
| NODE = 1 | 2.2710 | 0.0000 | 2.2710 | 3.4182 | D 23 | |
| NODE = 2 | 2.1058 | -.1610 | 2.2669 | -2.9108 | 0 | |
| NODE = 3 | 1.9623 | -.3045 | 2.2668 | -.0000 | 0 | |
| NODE = 4 | 1.8439 | -.4222 | 2.2660 | .0000 | D 1 | |
| NODE = 5 | 1.7534 | -.5092 | 2.2626 | -4.3308 | 0 | B |
| NODE = 6 | 1.7219 | -.5381 | 2.2600 | 4.5720 | D 9 | |
| NODE = 7 | 1.6763 | -.5806 | 2.2569 | 1.9553 | 0 | |
| NODE = 8 | 1.6638 | -.5927 | 2.2565 | -2.3669 | 0 | |
| NODE = 9 | 1.6857 | -.5678 | 2.2535 | -3.8673 | D 2 | |
| NODE = 10 | 1.7424 | -.5094 | 2.2518 | 4.3709 | | |

| FOIL = 2 | RINITIAL | RADIAL DEFL | RFINAL | RADIAL FORCE | OVERLAP PAIRS | B.C. |
|---|---|---|---|---|---|---|
| | | | | | 0 | B |
| NODE = 11 | 2.2710 | 0.0000 | 2.2710 | 3.6416 | I 9 | |
| NODE = 12 | 2.1058 | -.1621 | 2.2679 | -3.2045 | 0 | |
| NODE = 13 | 1.9623 | -.3058 | 2.2681 | -.0000 | 0 | |
| NODE = 14 | 1.8439 | -.4231 | 2.2669 | .0000 | I 2 | |
| NODE = 15 | 1.7534 | -.5094 | 2.2628 | -5.9744 | 0 | B |
| NODE = 16 | 1.7219 | -.5381 | 2.2600 | 7.0154 | D 41 | |
| NODE = 17 | 1.6763 | -.5820 | 2.2583 | 1.6381 | D 49 | |
| NODE = 18 | 1.6638 | -.5959 | 2.2597 | -2.3313 | 0 | |
| NODE = 19 | 1.6857 | -.5714 | 2.2570 | -5.0665 | D 3 | |
| NODE = 20 | 1.7424 | -.5107 | 2.2531 | 5.1497 | | |

| FOIL = 3 | RINITIAL | RADIAL DEFL | RFINAL | RADIAL FORCE | OVERLAP PAIRS | B.C. |
|---|---|---|---|---|---|---|
| | | | | | 0 | B |
| NODE = 21 | 2.2710 | 0.0000 | 2.2710 | 3.5906 | I 41 | |
| NODE = 22 | 2.1058 | -.1634 | 2.2693 | -2.8889 | I 49 | |
| NODE = 23 | 1.9623 | -.3085 | 2.2707 | -.0549 | 0 | |
| NODE = 24 | 1.8439 | -.4260 | 2.2699 | -.0000 | I 3 | |
| NODE = 25 | 1.7534 | -.5107 | 2.2641 | -10.0389 | 0 | B |
| NODE = 26 | 1.7219 | -.5381 | 2.2600 | 11.8934 | D 48 | |
| NODE = 27 | 1.6763 | -.5814 | 2.2577 | .5432 | D 43 | |
| NODE = 28 | 1.6638 | -.5962 | 2.2600 | -1.5082 | 0 | |
| NODE = 29 | 1.6857 | -.5727 | 2.2584 | -6.3753 | D 4 | |
| NODE = 30 | 1.7424 | -.5116 | 2.2541 | 5.7119 | | |

| FOIL = 4 | RINITIAL | RADIAL DEFL | RFINAL | RADIAL FORCE | OVERLAP PAIRS | B.C. |
|---|---|---|---|---|---|---|
| | | | | | 0 | B |
| NODE = 31 | 2.2710 | 0.0000 | 2.2710 | 3.0854 | I 48 | |
| NODE = 32 | 2.1058 | -.1629 | 2.2687 | -1.7832 | I 43 | B |
| NODE = 33 | 1.9623 | -.3087 | 2.2710 | -.2176 | 0 | B |
| NODE = 34 | 1.8439 | -.4271 | 2.2710 | .0774 | I 4 | |
| NODE = 35 | 1.7534 | -.5116 | 2.2651 | -14.6146 | 0 | B |
| NODE = 36 | 1.7219 | -.5381 | 2.2600 | 16.0994 | D 44 | |
| NODE = 37 | 1.6763 | -.5806 | 2.2568 | .1243 | D 31 | |
| NODE = 38 | 1.6638 | -.5953 | 2.2591 | -1.7527 | 0 | |
| NODE = 39 | 1.6857 | -.5720 | 2.2577 | -6.2060 | D 5 | |
| NODE = 40 | 1.7424 | -.5112 | 2.2537 | 5.6371 | | |

| FOIL = 5 | RINITIAL | RADIAL DEFL | RFINAL | RADIAL FORCE | OVERLAP PAIRS | B.C. |
|---|---|---|---|---|---|---|
| | | | | | 0 | B |
| NODE = 41 | 2.2710 | 0.0000 | 2.2710 | 2.8079 | I 44 | |
| NODE = 42 | 2.1058 | -.1620 | 2.2678 | -1.3035 | I 31 | |
| NODE = 43 | 1.9623 | -.3079 | 2.2701 | -.6661 | 0 | |
| NODE = 44 | 1.8434 | -.4266 | 2.2704 | -.0000 | | |

0 0 5 2 3 86

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| NODE = 45 | 1.7539 | -.5112 | 2.2647 | -10.9911 | I 5 | | |
| NODE = 46 | 1.7219 | -.5381 | 2.2600 | 12.4327 | 0 | B | |
| NODE = 47 | 1.6763 | -.5799 | 2.2562 | .7875 | D 45 | | |
| NODE = 48 | 1.6638 | -.5934 | 2.2572 | -2.3039 | D 50 | | |
| NODE = 49 | 1.6857 | -.5694 | 2.2551 | -4.8871 | 0 | | |
| NODE = 50 | 1.7424 | -.5101 | 2.2525 | 4.9431 | D 6 | | |

| FOIL = 6 | RINITIAL | RADIAL DEFL | RFINAL | RADIAL FORCE | OVERLAP PAIRS | B.C. |
|---|---|---|---|---|---|---|
| NODE = 51 | 2.2710 | 0.0000 | 2.2710 | 3.1027 | 0 | B |
| NODE = 52 | 2.1058 | -.1613 | 2.2672 | -2.1116 | I 45 | |
| NODE = 53 | 1.9623 | -.3059 | 2.2682 | -.3494 | I 50 | |
| NODE = 54 | 1.8439 | -.4241 | 2.2679 | -.0000 | 0 | |
| NODE = 55 | 1.7534 | -.5101 | 2.2635 | -6.9245 | I 6 | |
| NODE = 56 | 1.7219 | -.5381 | 2.2600 | 7.6360 | 0 | B |
| NODE = 57 | 1.6763 | -.5799 | 2.2562 | 1.3977 | D 46 | |
| NODE = 58 | 1.6638 | -.5919 | 2.2557 | -2.6743 | 0 | |
| NODE = 59 | 1.6857 | -.5672 | 2.2529 | -3.3862 | 0 | |
| NODE = 60 | 1.7424 | -.5096 | 2.2520 | 4.1305 | D 7 | |

| FOIL = 7 | RINITIAL | RADIAL DEFL | RFINAL | RADIAL FORCE | OVERLAP PAIRS | B.C. |
|---|---|---|---|---|---|---|
| NODE = 61 | 2.2710 | 0.0000 | 2.2710 | 3.3830 | 0 | B |
| NODE = 62 | 2.1058 | -.1614 | 2.2672 | -2.7989 | I 46 | |
| NODE = 63 | 1.9623 | -.3052 | 2.2675 | -.0000 | 0 | |
| NODE = 64 | 1.8439 | -.4231 | 2.2669 | -.0000 | 0 | |
| NODE = 65 | 1.7534 | -.5096 | 2.2630 | -4.9872 | I 7 | |
| NODE = 66 | 1.7219 | -.5381 | 2.2600 | 5.3180 | 0 | B |
| NODE = 67 | 1.6763 | -.5796 | 2.2559 | 1.4417 | D 47 | |
| NODE = 68 | 1.6638 | -.5905 | 2.2543 | -2.4844 | 0 | |
| NODE = 69 | 1.6857 | -.5656 | 2.2513 | -2.7471 | 0 | |
| NODE = 70 | 1.7424 | -.5094 | 2.2518 | 3.6867 | D 8 | |

| FOIL = 8 | RINITIAL | RADIAL DEFL | RFINAL | RADIAL FORCE | OVERLAP PAIRS | B.C. |
|---|---|---|---|---|---|---|
| NODE = 71 | 2.2710 | 0.0000 | 2.2710 | 3.3583 | 0 | B |
| NODE = 72 | 2.1058 | -.1611 | 2.2669 | -2.7891 | I 47 | |
| NODE = 73 | 1.9623 | -.3047 | 2.2670 | -.0000 | 0 | |
| NODE = 74 | 1.8439 | -.4226 | 2.2664 | -.0000 | 0 | |
| NODE = 75 | 1.7534 | -.5094 | 2.2628 | -4.2809 | I 8 | |
| NODE = 76 | 1.7219 | -.5381 | 2.2600 | 4.4107 | 0 | B |
| NODE = 77 | 1.6763 | -.5796 | 2.2559 | 1.6164 | I 23 | |
| NODE = 78 | 1.6638 | -.5903 | 2.2541 | -2.3877 | 0 | |
| NODE = 79 | 1.6857 | -.5654 | 2.2511 | -2.7936 | 0 | |
| NODE = 80 | 1.7424 | -.5092 | 2.2516 | 3.6870 | I 1 | |

********** ECCENTRICITY= .004000

SHAFT LOADS

| NODE | TOTAL LOAD | FX | FY |
|---|---|---|---|
| 7 | -1.249 | 1.024 | .715 |
| 8 | -2.367 | 2.148 | .993 |
| 9 | -3.867 | 3.740 | .983 |
| 10 | -1.603 | 1.598 | .130 |
| 17 | -1.251 | 1.231 | -.219 |
| 18 | -2.346 | 2.240 | -.823 |
| 19 | -5.066 | 4.375 | -2.554 |
| 20 | -4.889 | 3.725 | -3.167 |
| 27 | -1.240 | .710 | -1.017 |
| 28 | -2.225 | .934 | -2.020 |
| 29 | -6.375 | 1.621 | -6.166 |
| 30 | -8.903 | .719 | -8.874 |
| 37 | -1.179 | -.207 | -1.161 |
| 38 | -2.419 | -.835 | -2.270 |
| 39 | -6.206 | -3.129 | -5.360 |
| 40 | -5.324 | -3.448 | -4.056 |
| 47 | -1.324 | -1.086 | -.758 |
| 48 | -2.653 | -2.408 | -1.114 |
| 49 | -4.287 | -4.727 | -1.242 |

| | | | |
|---|---|---|---|
| 56 | -1.481 | -1.375 | -.169 |
| 57 | -1.401 | -1.380 | .246 |
| 58 | -2.674 | -2.510 | .923 |
| 59 | -3.386 | -2.924 | 1.707 |
| 60 | -.857 | -.653 | .555 |
| 67 | -1.347 | -.771 | 1.105 |
| 68 | -2.484 | -1.043 | 2.255 |
| 69 | -2.747 | -.698 | 2.657 |
| 70 | -.594 | -.048 | .592 |
| 77 | -1.294 | .227 | 1.274 |
| 78 | -2.388 | .824 | 2.241 |
| 79 | -2.794 | 1.408 | 2.413 |
| 80 | -.644 | .417 | .491 |

**********

| RESULTANT FORCE-X | RESULTANT FORCE-Y | TOTAL FORCE | ANGLE |
|---|---|---|---|
| -.8981 | -21.6821 | 21.7007 | -3.1002 |

**********

ETIME. DATE 10/14/76. TIME 21.15.05. ELAPSED CPU TIME SINCE LAST CALL 0 HRS 0 MIN 4.439 SEC. THIS IS CALL 21.

********** THIS IS A CONVERGED CASE **********
NUMBER OF ITERATIONS= 19
MAXIMUM ERROR = .16594E+00 AT NODE 30

100

SECTION IV

THRUST BEARING ANALYTIC PROGRAM

## 4.1 General

A coupled elasticity and hydrodynamics computer simulation for the self acting compliant foil thrust bearing has been completed. This analytic program has been experimentally verified and has proved to be a valuable aid in permitting increased load capacity to be achieved. This program represents a major first-step in foil thrust bearing analytic capabilities.

This section discusses the analytic basis with examples of input and program results. In addition, a detailed discussion of analysis and experimental results is provided.

## 4.2 Thrust Bearing Analytical Program

The Thrust Foil Bearing Analytic Solution consists of a finite difference hydrodynamic analysis and a finite element elasticity routine, which exchange information to obtain a converged solution. As shown in the program logic diagram, Figure 38, the program commences by requiring a definition of the bearing geometry and initial film thickness. The starting film thickness is a user input requirement. The closer the initial film is to the converged solution, the more rapid the convergence of the elastohydrodynamics solution. Once the initial film and input parameters are defined, the program proceeds to the hydrodynamic analysis to determine a fluid pressure distribution and the resulting loads to be applied to the finite element elasticity routine. With these loads, the elasticity solution provides the foil deflections and consequently, the elasticity film distribution ($h_e$). With ($h_e$) and the hydrodynamic film ($h_H$) defined, a relaxation of the form:



82500

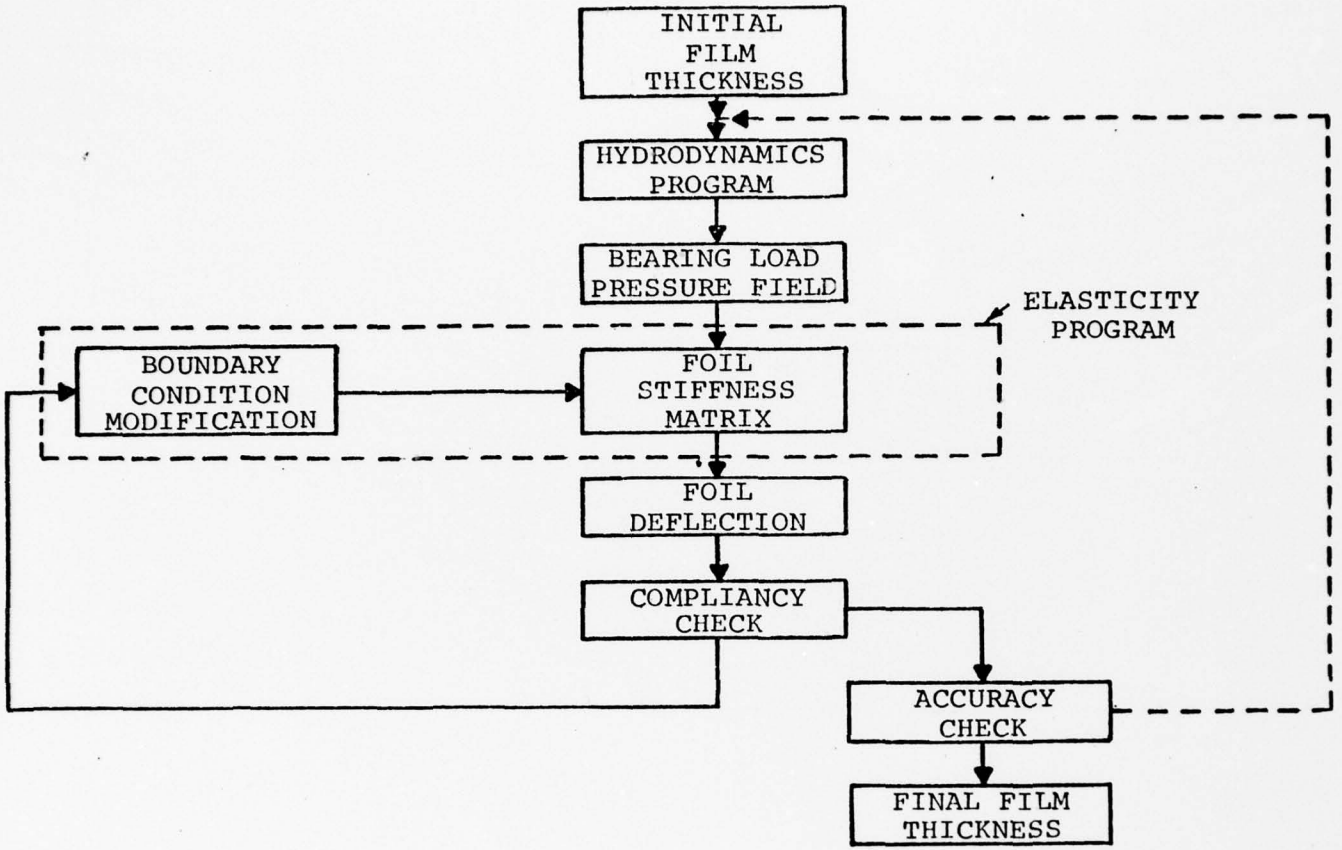



Figure 38. Elasto-Hydrodynamics Program Logic Diagram.



525 00

$$h_H^{(i)} = \alpha h_e^{(i-1)} + (1 - \alpha)\, h_H^{(i-1)}$$

Where:

(i) is the iteration index
$\alpha$ is the relaxation parameter

permits redefinition of a new hydrodynamic film and the cycle continues. When the film distribution used in the hydrodynamics ($h_H^{i-1}$) is the same as that predicted by the elasticity routine ($h_e^{i-1}$) then convergence is achieved as:

$$h_H^{(i)} \cong h_e^{(i-1)} \cong h_H^{(i-1)}$$

4.3 Elasticity Solution

The elasticity solution is a three-dimensional triangular-plate finite element representation of the foil with provisions for assigning spring stiffness at prescribed nodal locations. This linear elasticity solution contains provisions for evaluating thermal effects, including that due to thermal gradients across the plate thickness. The elasticity routine accepts the pressure distribution, as determined by the hydrodynamic finite difference solution. The pressure loading is then integrated for nodal loads, which provide foil deformations for the linear elasticity solution. Special boundary conditions such as symmetry are directly provided by proper conditioning of the finite element elasticity matrix. A schematic of a typical thrust bearing model, illustrating the finite difference and finite element grids is shown in Figure 39.

The finite element grid consists of triangular shell elements. As shown in Figure 40, three cartesian components of translation and rotations at each of the three mid-thickness vertex are provided.



62500

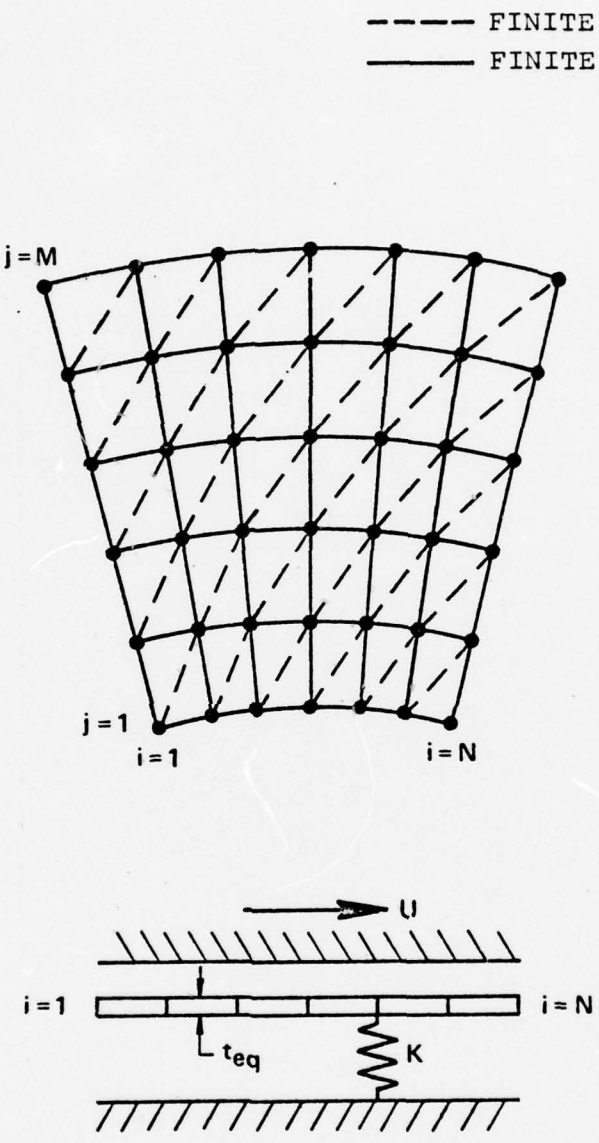



Figure 39. Thrust Foil Bearing Mathematical Model.



62500

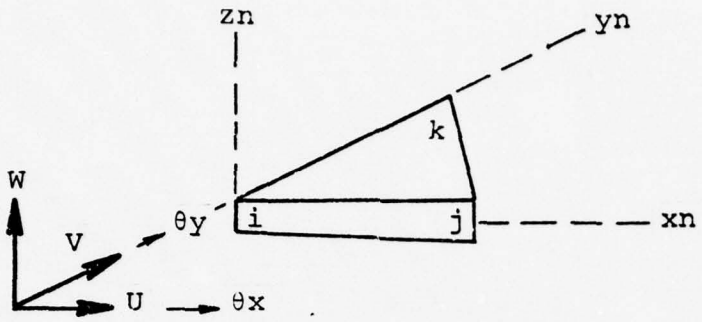



Figure 40. Finite Element Grid.

The local coordinate system shown in Figure 40 is utilized in the computations but foil elasticity deflections are reported by the program in a global coordinate system.

## 4.4 Hydrodynamics Solution

The thrust foil bearing subroutine termed the hydrodynamics program of Figure 38 is a finite difference solution to the Reynolds equation. Based upon the assumptions that:

(a) The axial clearance between bearing surfaces is much smaller than other bearing dimensions.

(b) The flow may be laminar or turbulent.

(c) Both bearing surfaces are wet.

(d) The velocity gradients across the fluid film are much larger than other velocity gradients.

(e) Body forces, pressures, viscosity and density are invariant across the lubricant film.



62500

(f) The working fluid may be compressible or incompressible.

(g) $\rho = P/RT$ (Isothermal conditions).

The Reynold's equation can be expressed in a cartesian frame as:

$$\frac{\partial}{\partial x}\left[\frac{P}{k_x}\frac{h^3}{\mu}\left(\frac{\partial P}{\partial x} - \bar{X}\right)\right] + \frac{\partial}{\partial z}\left[\frac{P}{k_z}\frac{h^3}{\mu}\left(\frac{\partial P}{\partial z} - \bar{Z}\right)\right]$$

$$= 6\left[P\left(U_o - U_1\right)\frac{\partial h}{\partial x} + Ph\frac{\partial}{\partial x}\left(U_o + U_1\right)\right.$$

$$\left. + h\left(U_o + U_1\right)\frac{\partial P}{\partial x} + 2P\left(V_1 - V_o\right)\right]$$

Where subscripts (o) and (1) refer to velocity components at the surfaces indicated on Figure 41 and:

$P$ = the pressure

$\rho$ = the density

$\bar{X}$, $\bar{Z}$ = body forces

$U_o$, $V_o$, $U_1$, $V_1$ = velocity components

$h$ = film thickness

$\mu$ = viscosity

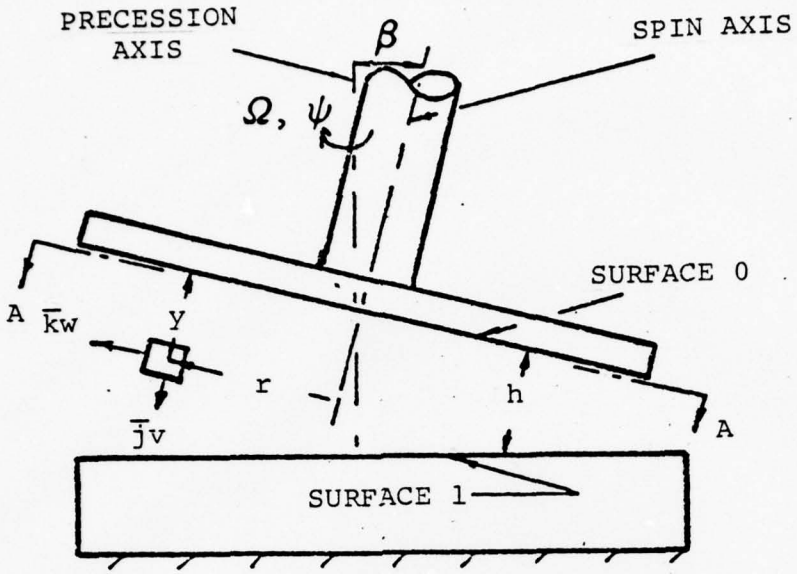
and the turbulence constants $k_x$ and $k_z$ are given by:

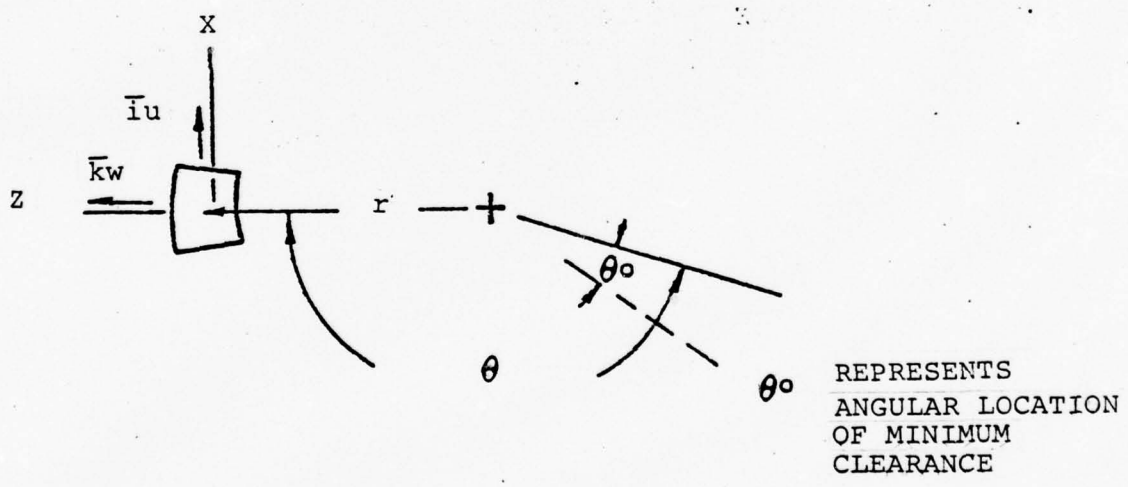
$$k_x = 12 + 0.53\ (k^2 R_e)^{0.725}$$

$$k_y = 12 + 0.296\ (k^2 R_e)^{0.65}$$



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VIEW "A-A"

Figure 41. Thrust Bearing Geometry.



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Where $R_e$ is the local Reynolds Number and Kappa (K) is the Prandtl's mixing length, which has been experimentally determined to be dependent upon the eccentricity ratio for plain journal bearings as shown in Figure 42 with analytic correlation per Figure 43.

Transformed to cylindrical coordinates, and accounting for the velocity terms, the Reynold's equation becomes:

$$\frac{\partial}{r\partial\theta}\left[\frac{P}{k_x}\ \frac{h^3}{\mu}\left(\frac{\partial}{r\partial\theta} - \bar{\theta}\right)\right] + \frac{\partial P}{\partial r}\left[\frac{P}{k_z}\ \frac{h^3}{\mu}\left(\frac{\partial P}{\partial r} - \bar{R}\right)\right]$$

$$= 6\left(\frac{PU_o}{r}\ \frac{\partial h}{\partial\theta} + \frac{hU_o\partial P}{r\ \partial\theta} + 2PV_1\right)$$

where:

$$V_1 = \frac{\partial h}{\partial t} - r\dot{\beta}\ \mathrm{COS}(\theta-\theta o) - r\dot{\psi}\beta\ \mathrm{SIN}(\theta-\theta o)$$

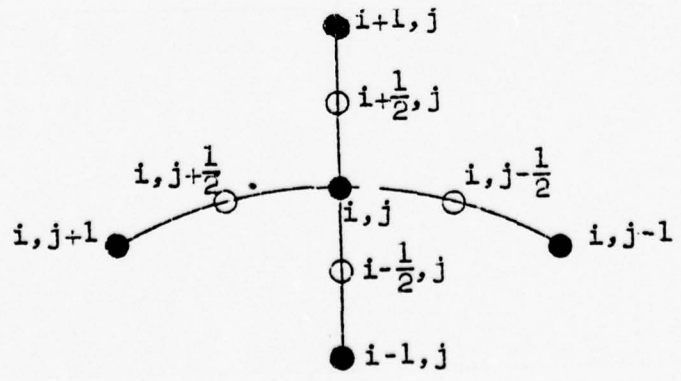
$$U_o = r\Omega$$

$\Omega$ = rotation speed

$\theta_o$ is the angular location of minimum film clearance

$\bullet$ implies derivative with respect to time

The Reynolds equation is written and solved in finite difference form to provide an expression for pressure at the point (i,j).






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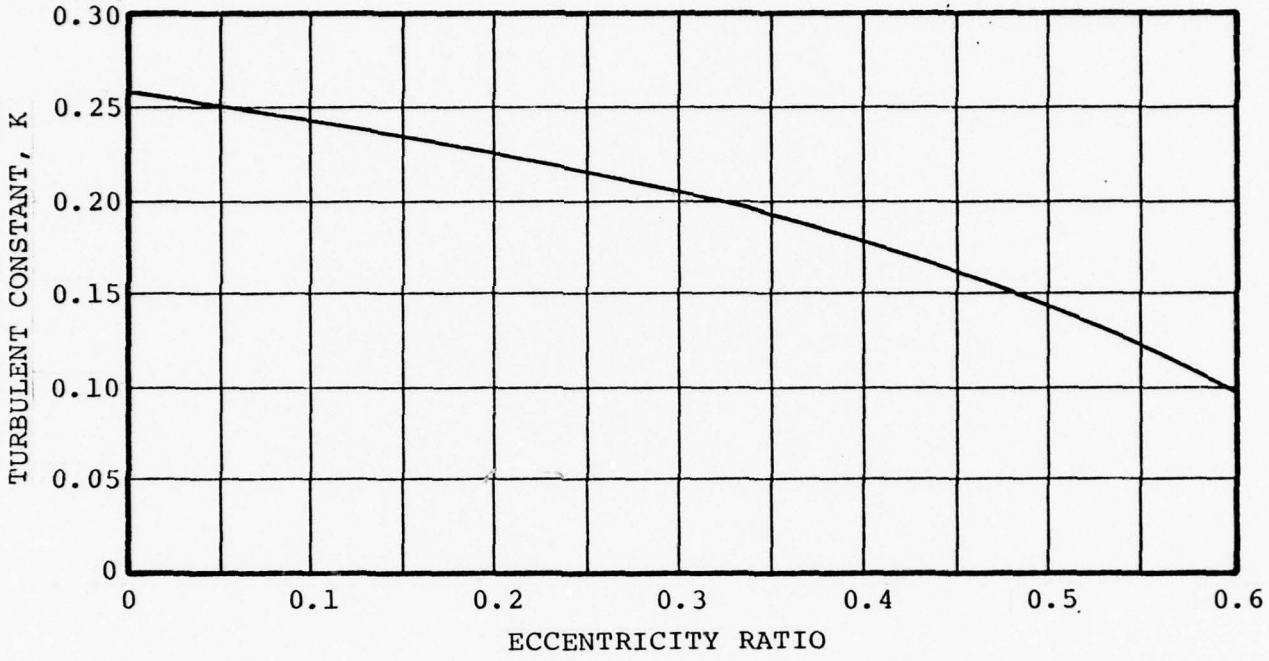



Figure 42. Experimental Correlation of Finite Difference Solution.

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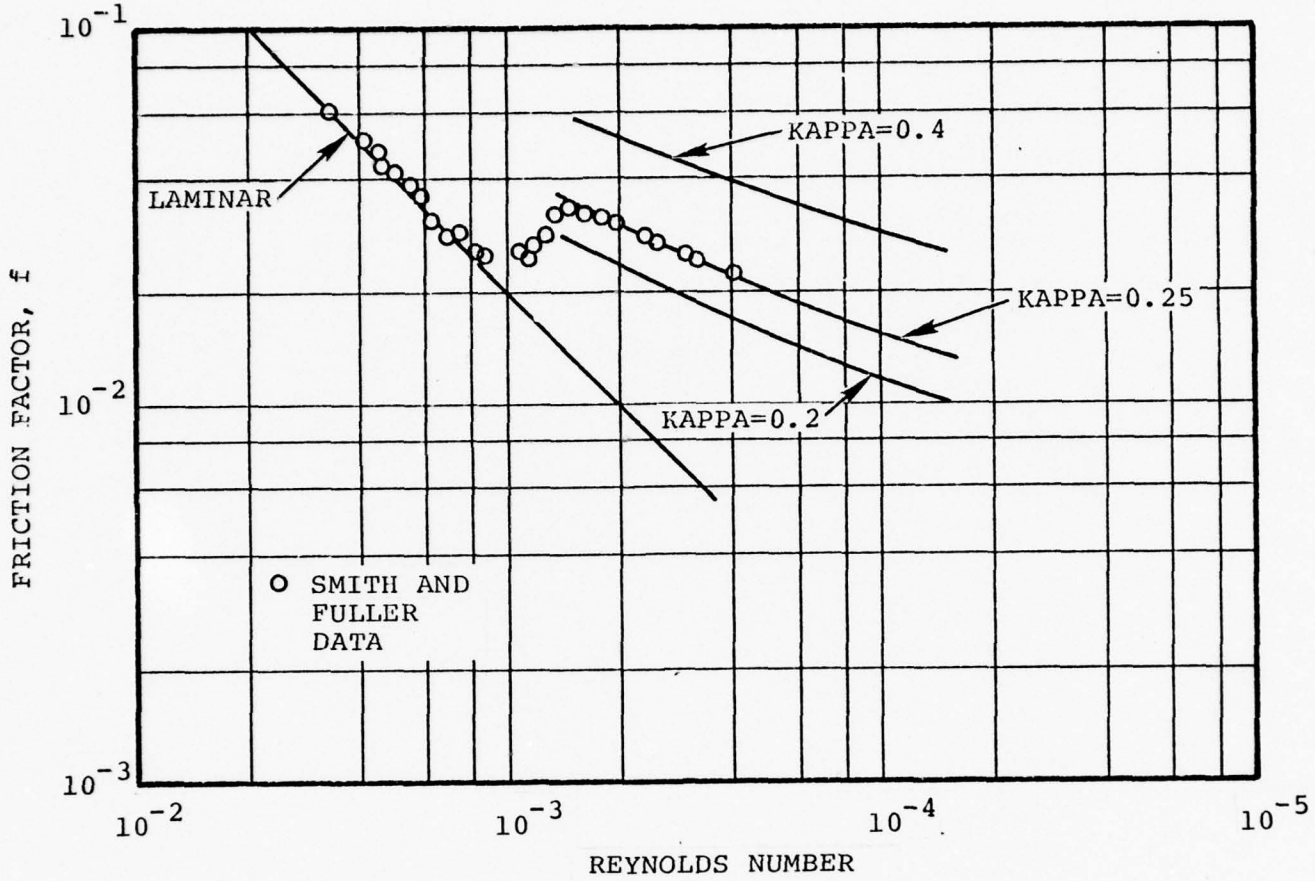



Figure 43. Dependency of Turbulence Constant on Bearing Eccenticity.

00529

Pressure distribution within the bearing is obtained by an iteration technique. The program includes the option of considering fluid inertia. Mean values of the fluid inertia terms $\rho\frac{Du}{Dt}$ and $\rho\frac{Dw}{Dt}$ are computed utilizing pressure distributions at intermediate stages of iteration and incorporated in subsequent iterations until the designated accuracy requirement is satisfied.

## 4.5 Computational Results

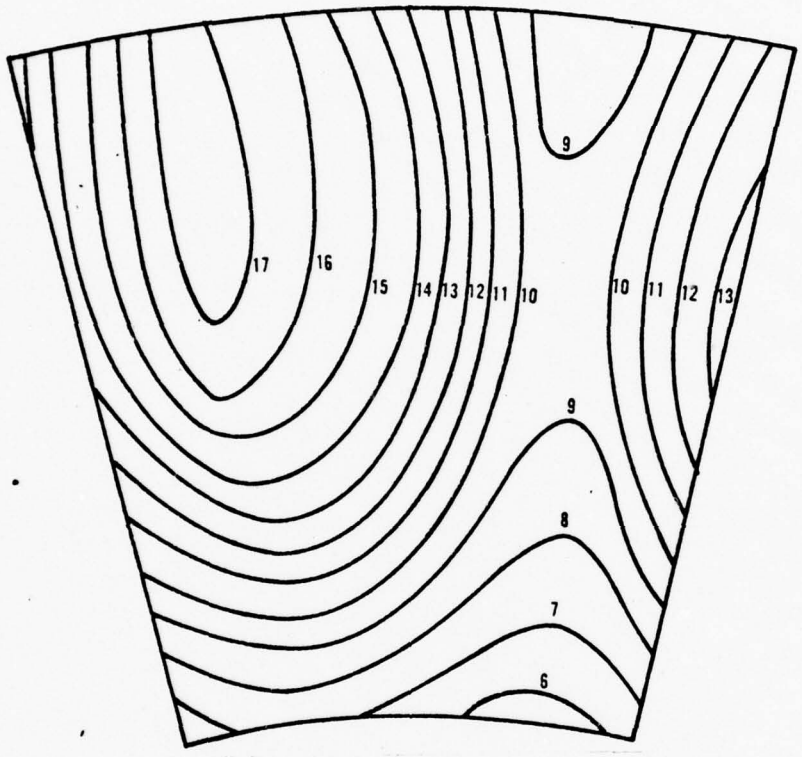
The baseline foil thrust bearing, as specified below, was first analyzed using this newly developed elasto-hydrodynamics computer program. Figures 44 and 45 show typical computer results of film thickness and film pressure distribution in isopleth form for one thrust bearing sector at a bearing load of 100 pounds (5 psi).

| | |
|---|---|
| Outside Diameter (OD) | 6.15 In. |
| Inside Diameter (ID) | 3.5 In. |
| Thickness of Foil ($T_1$) | 0.006 In. |
| Thickness of Foil Pad Plate ($T_2$) | 0.010 In. |
| Thickness of Stiffener ($T_3$) | 0.012 In. |
| Thickness of Spring Pad ($T_4$) | 0.012 In. |
| Number of Sectors (N) | 13 |

Figure 46 shows film thickness results and runner positions at the mean radius ($R = R_m$) for various bearing loading conditions. The effects of foil bearing compliance are also shown on Figure 46. Since the film shape becomes extremely steep at higher loading conditions (Figure 46), higher friction losses are expected. The bearing friction loss versus bearing load, as predicted by the analytical program is shown in Figure 47. Gas film pressure profiles along the mean radius line ($R = R_m$) for various bearing loading conditions are shown in Figure 48. The minimum film thickness, usually located near the bearing inside diameter (see Figure 44), is shown against the bearing load in Figure 49.



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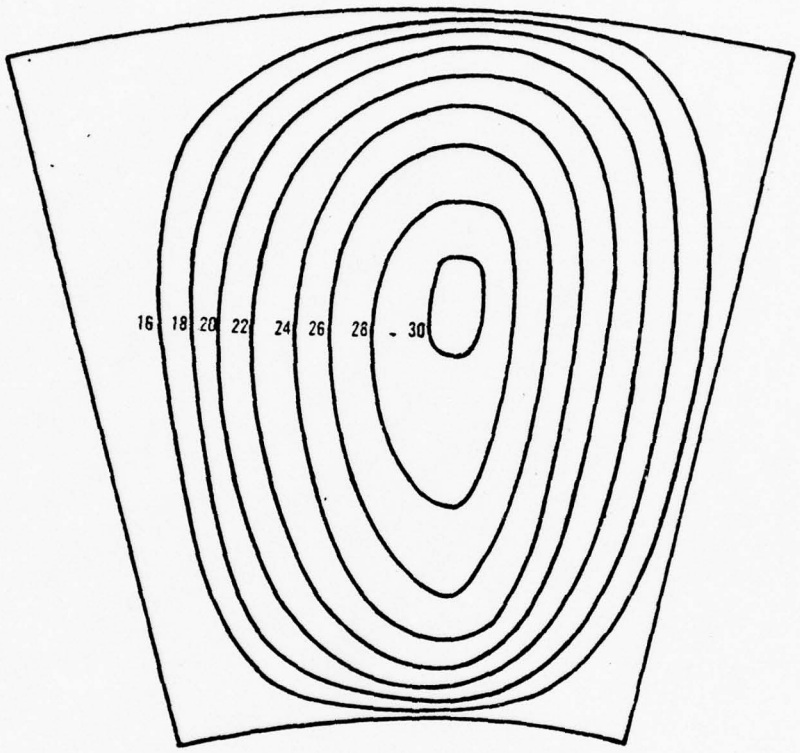

OD = 6.15 IN.
ID = 3.50 IN.
N = 33,000 RPM
Pa = 15 PSI

LOAD
CAPACITY = 100 LBS (5 PSI)

Figure 44. Baseline Bearing Film Thickness Isopleth (In./10,000)



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OD = 6.15 IN.
ID = 3.50 IN.
N = 33,000 RPM
Pa = 15 PSI

LOAD
CAPACITY = 100 LBS (5 PSI)

Figure 45. Baseline Bearing Film Pressure Isopleth (psi)



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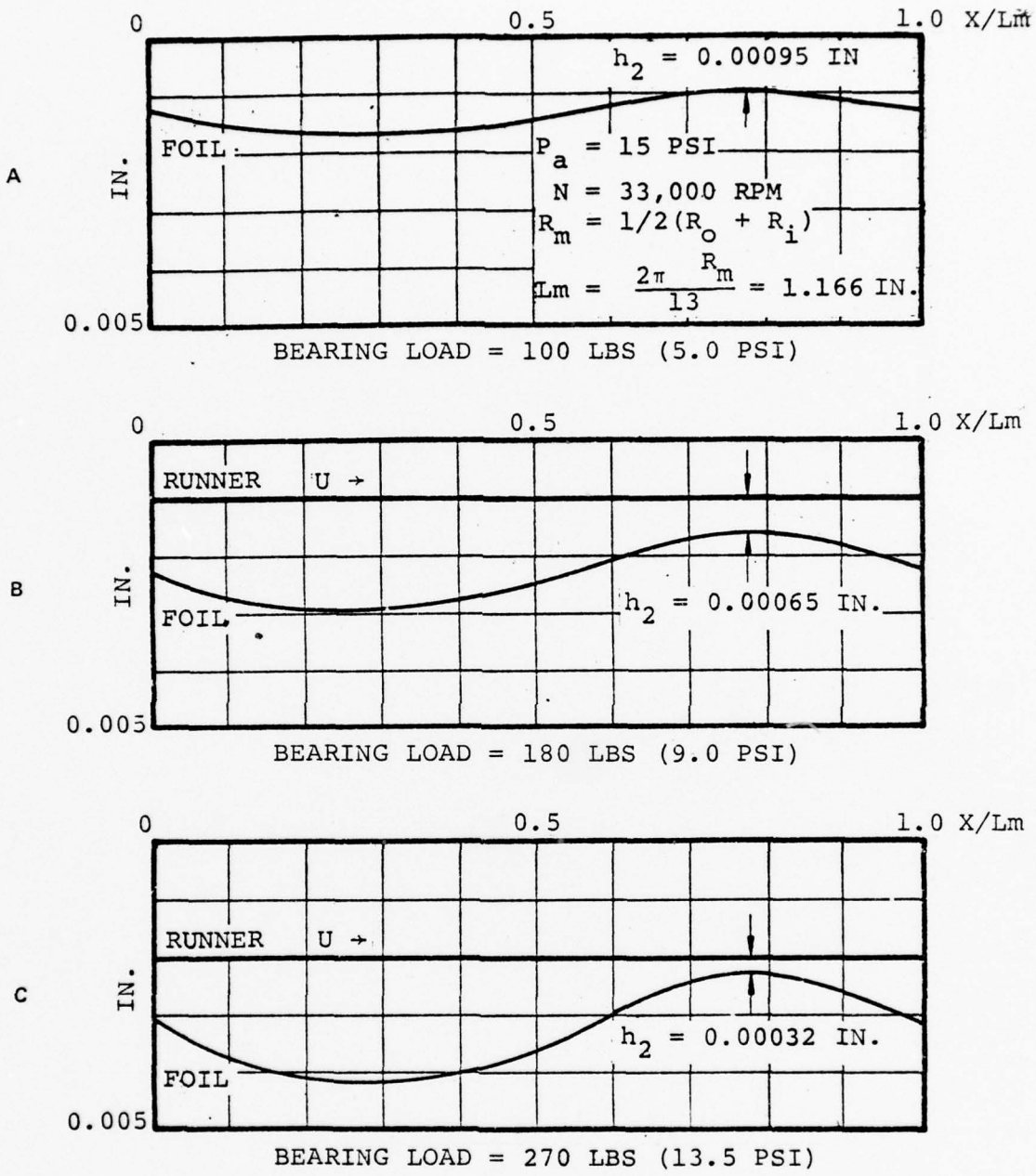



Figure 46. Film Thickness at $R_M$ for Baseline Thrust Bearing



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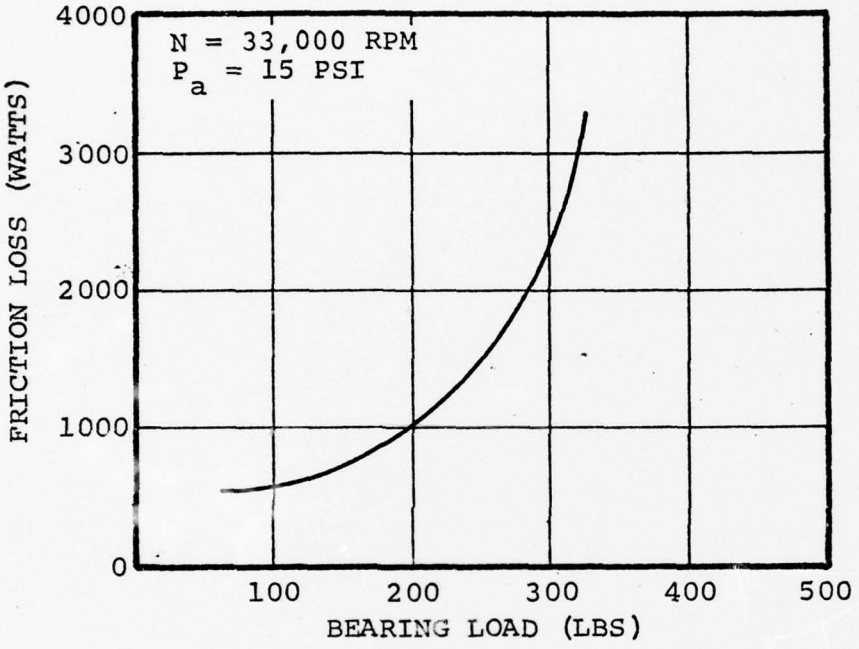



Figure 47. Baseline Bearing Friction Loss as Function of Bearing Load



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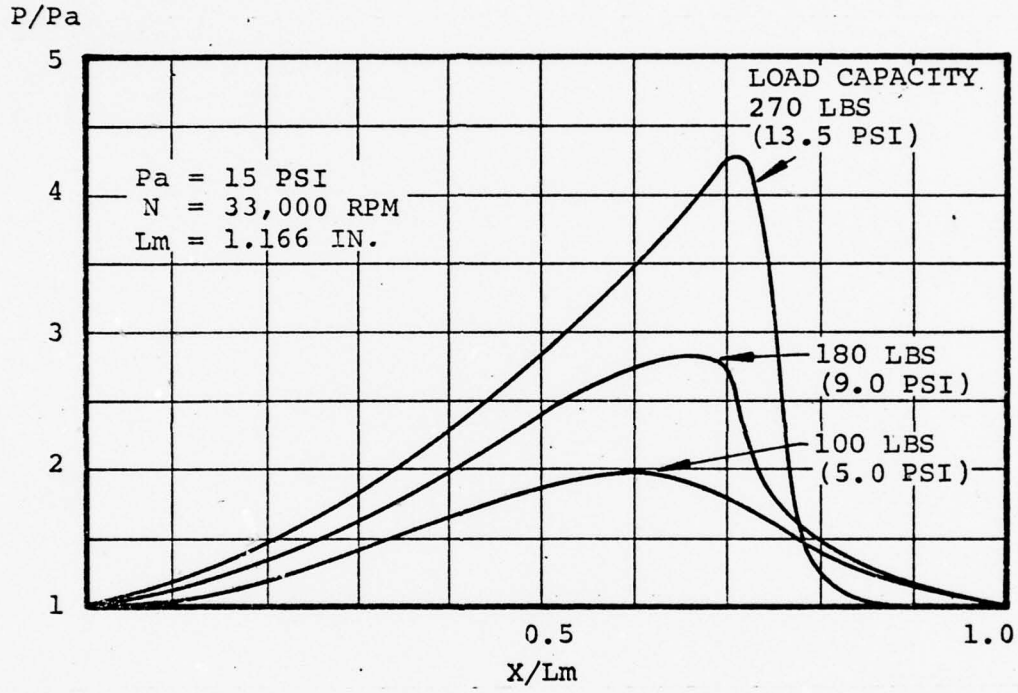



Figure 48. Pressure Profile at $R_M$ for Baseline Thrust Bearing



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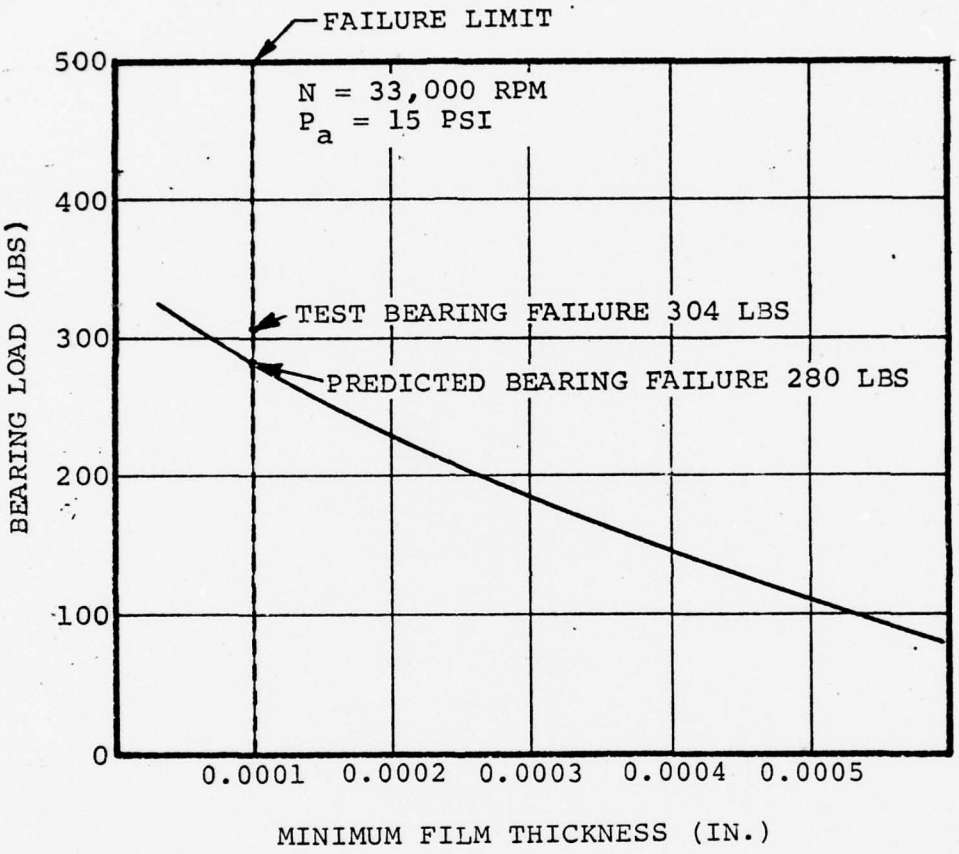



Figure 49. Baseline Bearing Load as Function of Minimum Film Thickness



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Bearing load capacity is predicted by using a minimum film thickness of 0.0001 inch. The baseline bearing was predicted to fail at a bearing load of 280 pounds by the analytical study.

The baseline thrust bearing was tested in the test rig. The bearing carried a load of 304 pounds. The rubbing pattern shown in that test clearly indicated that rubbing was initiated at the regions of minimum film thickness as predicted by the analytical results.

## 4.6 Thrust Bearing Computer Program

This paragraph presents the input data code followed by a sample configuration that has been analyzed by the CDC-6400 Program (Figure 50). A Fortran program listing is presented in Appendix C.

### 4.6.1 Input Data Presentation

Card 1 Format (10A8)

Word 1 - Comment card for hydrodynamics subroutine

Card 2 Format (6E 12.3)

Word 1 - Inside radius of bearing (inches)
Word 2 - Maximum radius of bearing (inches)
Word 3 - Fluid density ($lbsf/in^3$)
Word 4 - Fluid viscosity ($lbsf\text{-}sec/in^2$)
Word 5 - Vapor pressure (psi)
Word 6 - Ambient pressure (psi)

Card 3 Format (6E 12.3)

Word 1 - Turbulence constant (A value of 0.2 is recommended)
Word 2 - Critical turbulent Reynolds number



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Word 3 - Allowable extrapolation pressure error
(Recommend 0.001)

Word 4 - Pad span angle (degrees)

Word 5 - Hydrodynamic relaxation factor
(Recommend 0.5)

Word 6 - Minimum number of iterations (Default is 3)

Card 4 Format (6E12.3, 6X, I2)

Word 1 - Rotational speed (rpm)

Word 2 - Pivot coordinate radius (in)

Word 3 - Pivot coordinate angle (degrees from leading edge to center of pressure)

Word 4 - Pad radial slope (Geometric, use zero)

Word 5 - Pad tangential slope

Word 6 - Pivot clearance (in)

Word 7 - -Not used-

Card 5 Format (18I4)

Word 1 - No. of rows (m)

Word 2 - No. of columns (n)

Word 3 - Limit pressure iterations (Recommend 500)

Word 4 - Print number of iterations for pressure
(1 = Print, 2 = No print)

Word 5 = 2
Word 6 = 2
Word 7 = 1
Word 8 = 2
Word 9 = 2
Word 10 = 2
Word 11 = 2
Word 12 = 1

These values must be specified as indicated for proper operation of the hydrodydynamic solution for foil bearing analysis

Word 13 - Read flow (Incompressible = 1, Compressible = 2)

Word 14 - Fluid inertia (1 = yes, 2 = no)

Word 15 - Limit inertia iterations = 5

Word 16 = 2



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Word 17 = 2

Word 18 = 2

Card 5(O)* Format (48X, 2F 12.3)

Optional card for compressible flow

Word 1 - Gas constant ft/°R

Word 2 - Gas temperature °R

Card 6 Format (10 F7.2)

Words 1 through n - Read $\theta_1$ through $\theta_n$
(n defined as Word 2 of Card 5)

Card 7 Format (2I5, E12.3, I2, I6)

(Number of cards as required to describe each nodal correspondance between elasticity and hydrodynamics nodes. See Figure 50 for a typical grid)

Word 1 - Hydrodynamic Node n

Word 2 - Hydrodynamic Node m

Word 3 - Film clearance of node

Word 4 - Next card 1 = more cards to be read
2 = last card

Word 5 - Elasticity node number

Card 8 Format (E12.3)

Word 1 - Maximum permissible film (in)

Card 9

EOR - End of record (7/8/9) for hydrodynamics program

Card 10 Format (10A8)

"Stiffness"

Card 11 Format (10A8)

"End"

*This card is used only if Word 13, Card 5 equals 2.



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Cards 12 and 13 Format (10A8)

Comment cards for elasticity solution

Card 14 Format (10F 7.0)

Word 1 - Plate modulus of elasticity x $10^6$ psi
Word 2 - Number of specified springs per foil
Word 3 - Poisson's ratio of plate
Word 4 - Density (default = 0.16) $lbs/in^3$
Word 5 - RPM in X direction
Word 6 - Skew of X-Y plane to X axis of rotation
Word 7 - RPM in Z direction
Word 8 - Coefficient of thermal expansion (in/in °F) of plate
Word 9 - Relaxation factor for elasto-hydrodynamic iteration (recommend 0.12)
Word 10 - Number of special boundary conditions - Displacement nodal pairs (see Card 18)

Card 15 Format (F7.0, 9F9.0, 1X, I1, 7X, I1)

(One for each elasticity node)

Word 1 - Elasticity node number
Word 2 - Ux
Word 3 - Uy
Word 4 - Uz
Word 5 - θx
Word 6 - θy
Word 7 - θz

} Boundary condition code

Word 8 - x
Word 9 - y
Word 10 - z

} Cartesian coordinates of node

Word 11 - Last card 0 = more cards 15 to follow
1== last card
Word 12 - = 1 for skew symmetry independent node (triggers dependency of node (Word 1) for Card 18)



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Card 16 Format (F7.0, 9F9.0, 1X, I1)

(One for each triangular elasticity element)

Word 1 - Element Number

Word 2 - Node 1
Word 3 - Node 2
Word 4 - Node 3
} Three nodes watch for vortices of triangular plate

Word 5 - Element thickness (in.)

Word 6 - Modulus of elasticity of plate
(Default word 1. card 14)

Word 7 - Poisson's ratio of plate (default Word 3 - Card 14)

Word 8 - Temperature of top surface of plate (°F)

Word 9 - Temperature of bottom surface (°F)

Word 10 - Coefficient of thermal expansion of plate
(default Word 8 - Card 14)

Word 11 - Last card indicator 0 = another card to follow
1 = last card

Card 17 Format (7F7.0)

(Number of cards per Word 2 - Card 14)

Word 1 - Node with specified spring

Word 2 - Kx
Word 3 - Ky
Word 4 - Kz
} Spring stiffness (lbsf/in)

Word 5 - Kθx
Word 6 - Kθy
Word 7 - Kθz
} Rotational spring stiffness (in-lb/radian)

Card 18 Format (2F7.0)

(Number of cards per word 10 - Card 14)

Word 1 - Node 1
Word 2 - Node 2
} Displacement pair nodes

Card 19 Format (F7.0)

Word 1 - Number of Cards 20



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Card 20 Format (6F7.0)

Word 1 - Ux
Word 2 - Uy
Word 3 - Uz
Word 4 - θx
Word 5 - θy
Word 6 - θz

} Displacement preload on springs

Card 21

EOR - End of Record (7/8/9) for elasticity program

Card 22 Format (1X, I5, F14.8)
(One for each elasticity node)
Word 1 - Node number
Word 2 - Initial hydrodynamic film (in)

4.6.2 Sample Problem

To illustrate the use of this computer code, the computer input and results for the configuration depicted in Figure 50, are presented on the following pages.



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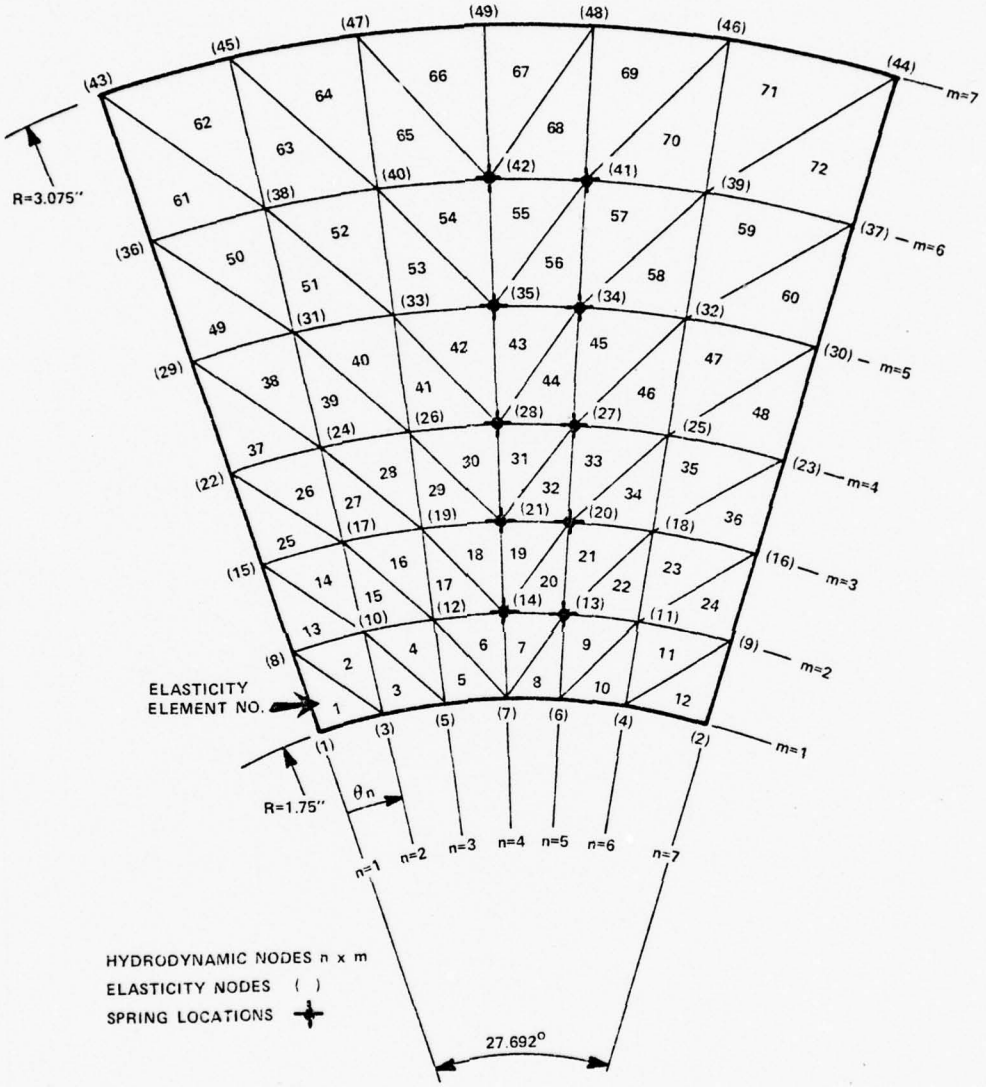



Figure 50. Sample Thrust Bearing Configuration



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SAMPLE INPUT FOR FOIL THRUST BEARING PROGRAM

```
FOIL THRUST BEARING NEW MODEL 1/1/75                                                    CARD 1
1.75        3.075              2.29E-5       .42E-8          15.          15.         CARD 2
.2          100000.     .001          27.692        .5                                CARD 3
33000.       0.          0.            0.            0.          .000001              CARD 4
   7   7 500   1   2   2   1   2   2   2   2   1   1   2   5   2   2   2             CARD 5
0.      5.91   15.14  17.63  19.29  21.78  27.692                                     CARD 6
    1   1   0.        1    1
    2   1   0.        1    8
    3   1   0.        1   15
    4   1   0.        1   22
    5   1   0.        1   29
    6   1   0.        1   36
    7   1   0.        1   43
    1   2   0.        1    3
    2   2   0.        1   10
    3   2   0.        1   17
    4   2   0.        1   24
    5   2   0.        1   31
    6   2   0.        1   38
    7   2   0.        1   45
    1   3   0.        1    5
    2   3   0.        1   12
    3   3   0.        1   19
    4   3   0.        1   26
    5   3   0.        1   33
    6   3   0.        1   40
    7   3   0.        1   47
    1   4   0.        1    7
    2   4   0.        1   14
    3   4   0.        1   21                                                          CARD 7
    4   4   0.        1   28
    5   4   0.        1   35
    6   4   0.        1   42
    7   4   0.        1   49
    1   5   0.        1    6
    2   5   0.        1   13
    3   5   0.        1   20
    4   5   0.        1   27
    5   5   0.        1   34
    6   5   0.        1   41
    7   5   0.        1   48
    1   6   0.        1    4
    2   6   0.        1   11
    3   6   0.        1   18
    4   6   0.        1   25
    5   6   0.        1   32
    6   6   0.        1   39
    7   6   0.        1   46
    1   7   0.        1    2
    2   7   0.        1    9
    3   7   0.        1   16
    4   7   0.        1   23
    5   7   0.        1   30
    6   7   0.        1   37
    7   7   0.        2   44                                                          CARD 8
  .015                                                                              CARD 10
STIFFNESS                                                                           CARD 11
END                                                                                 CARD 12
.000001500.                                                                         CARD 13
FOIL THRUST BEARING-BOSS1 SOLUTION                                                  CARD 14
29.    10.    .3     0.     0.     27.692 0.          .12          7                CARD 15
1.     3.     2.     2.     2.     2.     3.     0.     1.750  0.
```



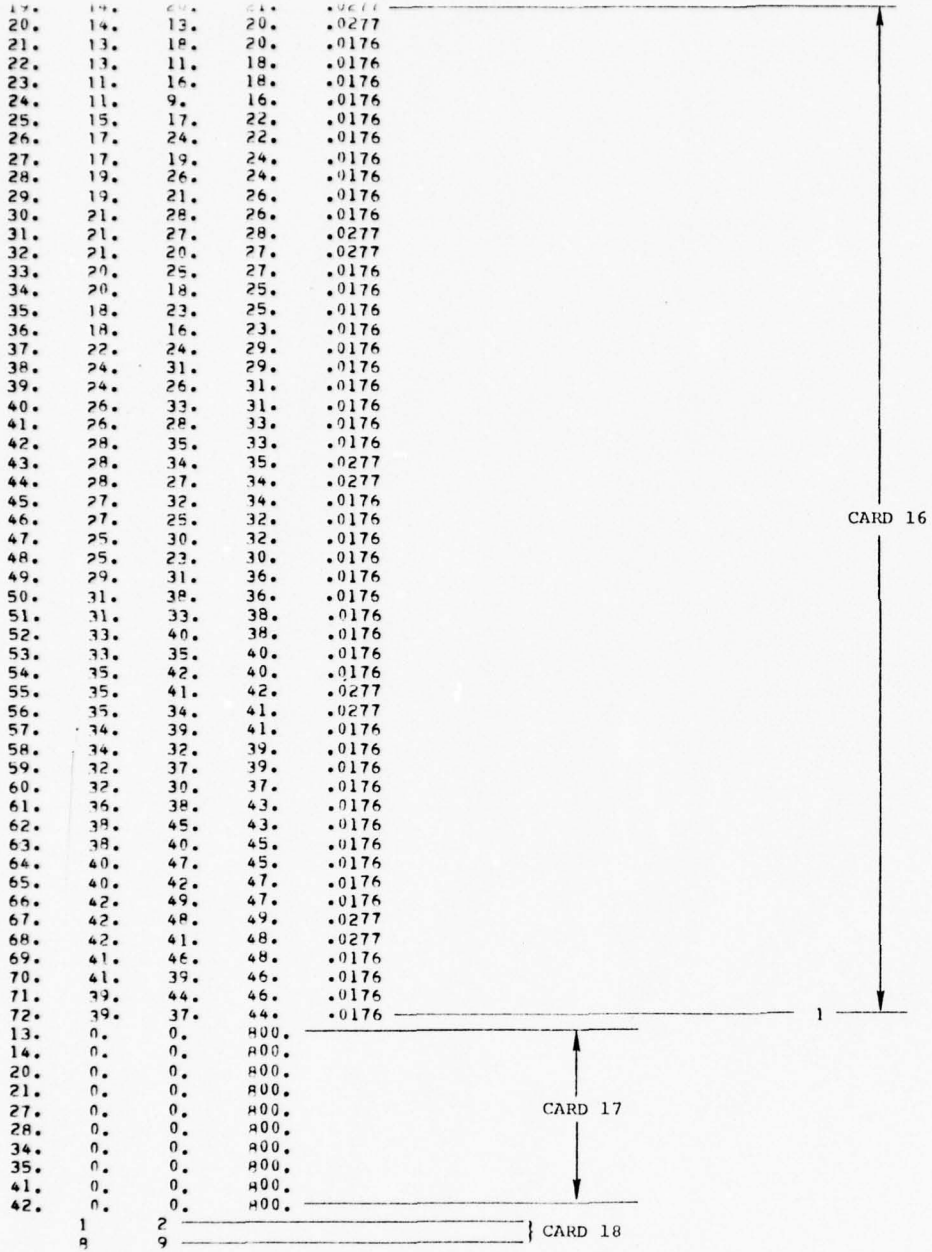
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| | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| [illegible] | | | | | | | .813 | 1.550 | 0. | 1 |
| 3. | 2. | 2. | 2. | 2. | 2. | 2. | .180 | 1.741 | 0. | |
| 4. | 2. | 2. | 2. | 2. | 2. | 2. | .649 | 1.625 | 0. | |
| 5. | 2. | 2. | 2. | 2. | 2. | 2. | .457 | 1.689 | 0. | |
| 6. | 2. | 2. | 2. | 2. | 2. | 2. | .578 | 1.652 | 0. | |
| 7. | 2. | 2. | 2. | 2. | 2. | 2. | .530 | 1.668 | 0. | |
| 8. | 3. | 2. | 2. | 2. | 2. | 3. | 0. | 1.971 | 0. | |
| 9. | 3. | 2. | 2. | 2. | 2. | 3. | .916 | 1.745 | 0. | 1 |
| 10. | 2. | 2. | 2. | 2. | 2. | 2. | .203 | 1.961 | 0. | |
| 11. | 2. | 2. | 2. | 2. | 2. | 2. | .731 | 1.830 | 0. | |
| 12. | 2. | 2. | 2. | 2. | 2. | 2. | .515 | 1.903 | 0. | |
| 13. | 2. | 2. | 2. | 2. | 2. | 2. | .651 | 1.860 | 0. | |
| 14. | 2. | 2. | 2. | 2. | 2. | 2. | .597 | 1.878 | 0. | |
| 15. | 3. | 2. | 2. | 2. | 2. | 3. | 0. | 2.192 | 0. | |
| 16. | 3. | 2. | 2. | 2. | 2. | 3. | 1.019 | 1.941 | 0. | 1 |
| 17. | 2. | 2. | 2. | 2. | 2. | 2. | .226 | 2.180 | 0. | |
| 18. | 2. | 2. | 2. | 2. | 2. | 2. | .813 | 2.036 | 0. | |
| 19. | 2. | 2. | 2. | 2. | 2. | 2. | .571 | 2.116 | 0. | |
| 20. | 2. | 2. | 2. | 2. | 2. | 2. | .724 | 2.069 | 0. | |
| 21. | 2. | 2. | 2. | 2. | 2. | 2. | .664 | 2.089 | 0. | |
| 22. | 3. | 2. | 2. | 2. | 2. | 3. | 0. | 2.412 | 0. | |
| 23. | 3. | 2. | 2. | 2. | 2. | 3. | 1.121 | 2.136 | 0. | 1 |
| 24. | 2. | 2. | 2. | 2. | 2. | 2. | .248 | 2.399 | 0. | |
| 25. | 2. | 2. | 2. | 2. | 2. | 2. | .895 | 2.240 | 0. | |
| 26. | 2. | 2. | 2. | 2. | 2. | 2. | .630 | 2.328 | 0. | |
| 27. | 2. | 2. | 2. | 2. | 2. | 2. | .797 | 2.277 | 0. | |
| 28. | 2. | 2. | 2. | 2. | 2. | 2. | .731 | 2.299 | 0. | |
| 29. | 3. | 2. | 2. | 2. | 2. | 3. | 0. | 2.633 | 0. | |
| 30. | 3. | 2. | 2. | 2. | 2. | 3. | 1.224 | 2.331 | 0. | 1 |
| 31. | 2. | 2. | 2. | 2. | 2. | 2. | .271 | 2.619 | 0. | |
| 32. | 2. | 2. | 2. | 2. | 2. | 2. | .977 | 2.445 | 0. | |
| 33. | 2. | 2. | 2. | 2. | 2. | 2. | .688 | 2.542 | 0. | |
| 34. | 2. | 2. | 2. | 2. | 2. | 2. | .870 | 2.485 | 0. | |
| 35. | 2. | 2. | 2. | 2. | 2. | 2. | .797 | 2.509 | 0. | |
| 36. | 3. | 2. | 2. | 2. | 2. | 3. | 0. | 2.854 | 0. | |
| 37. | 3. | 2. | 2. | 2. | 2. | 3. | 1.326 | 2.527 | 0. | 1 |
| 38. | 2. | 2. | 2. | 2. | 2. | 2. | .294 | 2.839 | 0. | |
| 39. | 2. | 2. | 2. | 2. | 2. | 2. | 1.059 | 2.650 | 0. | |
| 40. | 2. | 2. | 2. | 2. | 2. | 2. | .745 | 2.755 | 0. | |
| 41. | 2. | 2. | 2. | 2. | 2. | 2. | .943 | 2.694 | 0. | |
| 42. | 2. | 2. | 2. | 2. | 2. | 2. | .864 | 2.720 | 0. | |
| 43. | 3. | 2. | 2. | 2. | 2. | 3. | 0. | 3.075 | 0. | |
| 44. | 3. | 2. | 2. | 2. | 2. | 3. | 1.429 | 2.723 | 0. | 1 |
| 45. | 2. | 2. | 2. | 2. | 2. | 2. | .317 | 3.059 | 0. | |
| 46. | 2. | 2. | 2. | 2. | 2. | 2. | 1.141 | 2.855 | 0. | |
| 47. | 2. | 2. | 2. | 2. | 2. | 2. | .803 | 2.968 | 0. | |
| 48. | 2. | 2. | 2. | 2. | 2. | 2. | 1.016 | 2.902 | 0. | |
| 49. | 2. | 2. | 2. | 2. | 2. | 2. | .931 | 2.931 | 0. | 1 |

CARD 15

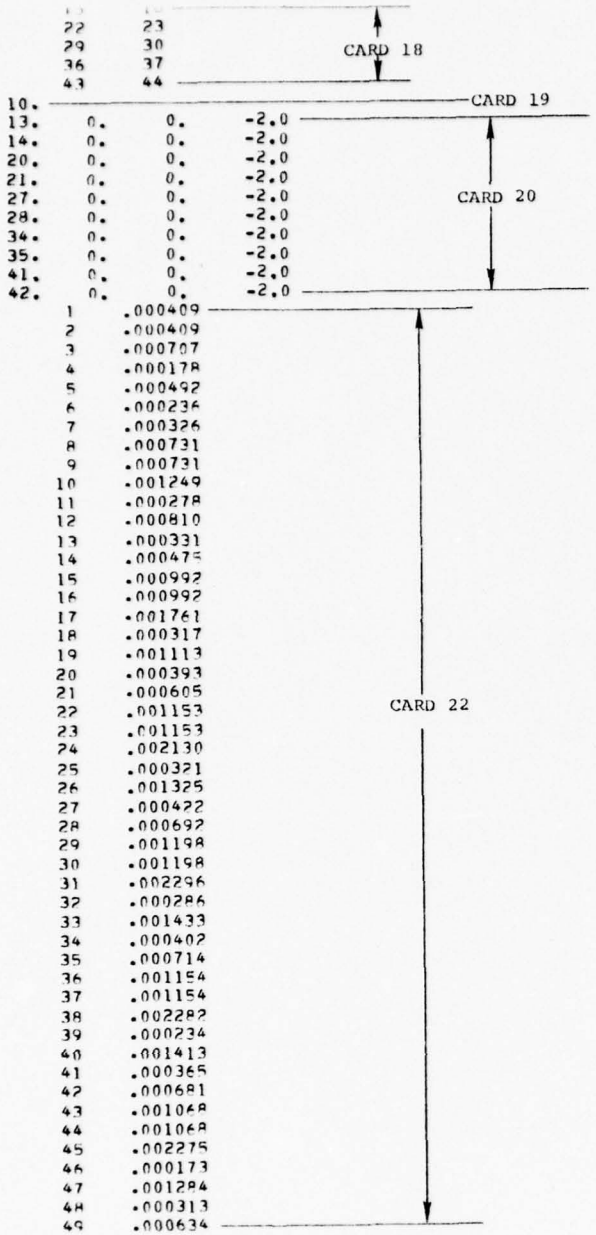
| | | | | |
|---|---|---|---|---|
| 1. | 1. | 3. | 8. | .0176 |
| 2. | 3. | 10. | 8. | .0176 |
| 3. | 3. | 5. | 10. | .0176 |
| 4. | 5. | 12. | 10. | .0176 |
| 5. | 5. | 7. | 12. | .0176 |
| 6. | 7. | 14. | 12. | .0176 |
| 7. | 7. | 13. | 14. | .0277 |
| 8. | 7. | 6. | 13. | .0277 |
| 9. | 6. | 11. | 13. | .0176 |
| 10. | 6. | 4. | 11. | .0176 |
| 11. | 4. | 9. | 11. | .0176 |
| 12. | 4. | 2. | 9. | .0176 |
| 13. | 8. | 10. | 15. | .0176 |
| 14. | 10. | 17. | 15. | .0176 |
| 15. | 10. | 12. | 17. | .0176 |
| 16. | 12. | 19. | 17. | .0176 |
| 17. | 12. | 14. | 19. | .0176 |
| 18. | 14. | 21. | 19. | .0176 |

CARD 16


19. 14. 20. 21. .0277
20. 14. 13. 20. .0277
21. 13. 18. 20. .0176
22. 13. 11. 18. .0176
23. 11. 16. 18. .0176
24. 11. 9. 16. .0176
25. 15. 17. 22. .0176
26. 17. 24. 22. .0176
27. 17. 19. 24. .0176
28. 19. 26. 24. .0176
29. 19. 21. 26. .0176
30. 21. 28. 26. .0176
31. 21. 27. 28. .0277
32. 21. 20. 27. .0277
33. 20. 25. 27. .0176
34. 20. 18. 25. .0176
35. 18. 23. 25. .0176
36. 18. 16. 23. .0176
37. 22. 24. 29. .0176
38. 24. 31. 29. .0176
39. 24. 26. 31. .0176
40. 26. 33. 31. .0176
41. 26. 28. 33. .0176
42. 28. 35. 33. .0176
43. 28. 34. 35. .0277
44. 28. 27. 34. .0277
45. 27. 32. 34. .0176
46. 27. 25. 32. .0176
47. 25. 30. 32. .0176
48. 25. 23. 30. .0176
49. 29. 31. 36. .0176
50. 31. 38. 36. .0176
51. 31. 33. 38. .0176
52. 33. 40. 38. .0176
53. 33. 35. 40. .0176
54. 35. 42. 40. .0176
55. 35. 41. 42. .0277
56. 35. 34. 41. .0277
57. 34. 39. 41. .0176
58. 34. 32. 39. .0176
59. 32. 37. 39. .0176
60. 32. 30. 37. .0176
61. 36. 38. 43. .0176
62. 38. 45. 43. .0176
63. 38. 40. 45. .0176
64. 40. 47. 45. .0176
65. 40. 42. 47. .0176
66. 42. 49. 47. .0176
67. 42. 48. 49. .0277
68. 42. 41. 48. .0277
69. 41. 46. 48. .0176
70. 41. 39. 46. .0176
71. 39. 44. 46. .0176
72. 39. 37. 44. .0176
CARD 16
1
13. 0. 0. 800.
14. 0. 0. 800.
20. 0. 0. 800.
21. 0. 0. 800.
27. 0. 0. 800.
28. 0. 0. 800.
34. 0. 0. 800.
35. 0. 0. 800.
41. 0. 0. 800.
42. 0. 0. 800.
CARD 17
1 2
8 9
CARD 18



82500


22 23
29 30
36 37
43 44
CARD 18
10.
CARD 19
13. 0. 0. -2.0
14. 0. 0. -2.0
20. 0. 0. -2.0
21. 0. 0. -2.0
27. 0. 0. -2.0
28. 0. 0. -2.0
34. 0. 0. -2.0
35. 0. 0. -2.0
41. 0. 0. -2.0
42. 0. 0. -2.0
CARD 20
1 .000409
2 .000409
3 .000707
4 .000178
5 .000492
6 .000236
7 .000326
8 .000731
9 .000731
10 .001249
11 .000278
12 .000810
13 .000331
14 .000475
15 .000992
16 .000992
17 .001761
18 .000317
19 .001113
20 .000393
21 .000605
22 .001153
23 .001153
24 .002130
25 .000321
26 .001325
27 .000422
28 .000692
29 .001198
30 .001198
31 .002296
32 .000286
33 .001433
34 .000402
35 .000714
36 .001154
37 .001154
38 .002282
39 .000234
40 .001413
41 .000365
42 .000681
43 .001068
44 .001068
45 .002275
46 .000173
47 .001284
48 .000313
49 .000634
CARD 22



62500

# SAMPLE PROBLEM OUTPUT FOR CONVERGED CASE

HYDRODYNAMIC THRUST BEARING PROGRAM S08-1

FOIL THRUST BEARING NEW MODEL 1/1/75

NBAR= -0

I = 1

| J | CLEARANCE | PRESSURE | CODE | J | CLEARANCE | PRESSURE | CODE | J | CLEARANCE | PRESSURE | CODE |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | .38145E-03 | .15000E+02 | 1 | 2 | .71960E-03 | .15000E+02 | 1 | 3 | .48615E-03 | .15000E+02 | 1 |
| 4 | .30004E-03 | .15000E+02 | 1 | 5 | .19653E-03 | .15000E+02 | 1 | 6 | .12838E-03 | .15000E+02 | 1 |
| 7 | .38145E-03 | .15000E+02 | 1 | | | | | | | | |

I = 2

| J | CLEARANCE | PRESSURE | CODE | J | CLEARANCE | PRESSURE | CODE | J | CLEARANCE | PRESSURE | CODE |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | .68958E-03 | .15000E+02 | 1 | 2 | .12774E-02 | .15000E+02 | 0 | 3 | .80041E-03 | .15000E+02 | 0 |
| 4 | .42445E-03 | .15000E+02 | 0 | 5 | .26083E-03 | .15000E+02 | 0 | 6 | .19221E-03 | .15000E+02 | 0 |
| 7 | .68958E-03 | .15000E+02 | 1 | | | | | | | | |

I = 3

| J | CLEARANCE | PRESSURE | CODE | J | CLEARANCE | PRESSURE | CODE | J | CLEARANCE | PRESSURE | CODE |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | .93772E-03 | .15000E+02 | 1 | 2 | .18022E-02 | .15000E+02 | 0 | 3 | .10988E-02 | .15000E+02 | 0 |
| 4 | .53441E-03 | .15000E+02 | 0 | 5 | .29541E-03 | .15000E+02 | 0 | 6 | .19748E-03 | .15000E+02 | 0 |
| 7 | .93772E-03 | .15000E+02 | 1 | | | | | | | | |

I = 4

| J | CLEARANCE | PRESSURE | CODE | J | CLEARANCE | PRESSURE | CODE | J | CLEARANCE | PRESSURE | CODE |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | .10932E-02 | .15000E+02 | 1 | 2 | .21788E-02 | .15000E+02 | 0 | 3 | .13059E-02 | .15000E+02 | 0 |
| 4 | .61103E-03 | .15000E+02 | 0 | 5 | .31194E-03 | .15000E+02 | 0 | 6 | .18747E-03 | .15000E+02 | 0 |
| 7 | .10932E-02 | .15000E+02 | 1 | | | | | | | | |

I = 5

| J | CLEARANCE | PRESSURE | CODE | J | CLEARANCE | PRESSURE | CODE | J | CLEARANCE | PRESSURE | CODE |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | .11441E-02 | .15000E+02 | 1 | 2 | .23477E-02 | .15000E+02 | 0 | 3 | .14160E-02 | .15000E+02 | 0 |
| 4 | .53782E-03 | .15000E+02 | 0 | 5 | .29975E-03 | .15000E+02 | 0 | 6 | .16071E-03 | .15000E+02 | 0 |
| 7 | .11441E-02 | .15000E+02 | 1 | | | | | | | | |

I = 6

| J | CLEARANCE | PRESSURE | CODE | J | CLEARANCE | PRESSURE | CODE | J | CLEARANCE | PRESSURE | CODE |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | .11105E-02 | .15000E+02 | 1 | 2 | .23345E-02 | .15000E+02 | 0 | 3 | .14020E-02 | .15000E+02 | 0 |
| 4 | .51781E-03 | .15000E+02 | 0 | 5 | .28124E-03 | .15000E+02 | 0 | 6 | .13045E-03 | .15000E+02 | 0 |
| 7 | .11105E-02 | .15000E+02 | 1 | | | | | | | | |

I = 7

| J | CLEARANCE | PRESSURE | CODE | J | CLEARANCE | PRESSURE | CODE | J | CLEARANCE | PRESSURE | CODE |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | .10346E-02 | .15000E+02 | 1 | 2 | .23334E-02 | .15000E+02 | 1 | 3 | .12797E-02 | .15000E+02 | 1 |
| 4 | .58708E-03 | .15000E+02 | 1 | 5 | .24355E-03 | .15000E+02 | 1 | 6 | .32870E-04 | .15000E+02 | 1 |
| 7 | .10346E-02 | .15000E+02 | 1 | | | | | | | | |

* * * \

| J | P | U(M) | W(M) | RE(T) | RE(R) | RE | CODE | J | P | U(M) | W(M) | RE(T) | RE(R) | RE | CODE |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 15.00 | 3023.78 | .00 | 16. | 0. | 33. | 1. | 2 | 15.00 | 3023.78 | -539.07 | 31. | -5. | 61. | 1. |
| 3 | 15.00 | 3023.78 | -1261.72 | 21. | -9. | 42. | 1. | 4 | 15.00 | 3023.78 | -673.92 | 13. | -3. | 26. | 1. |
| 5 | 15.00 | 3023.78 | -373.33 | 8. | -1. | 17. | 1. | 6 | 15.00 | 3023.78 | -17.12 | 5. | -0. | 11. | 1. |
| 7 | 15.00 | 3023.78 | .00 | 16. | 0. | 33. | 1. | 0 | 0.00 | 0.00 | 0.00 | 0. | 0. | 0. | 0. |

I = 2

| J | P | U(M) | W(M) | RE(T) | RE(R) | RE | CODE | J | P | U(M) | W(M) | RE(T) | RE(R) | RE | CODE |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 15.00 | 3243.94 | 0.00 | 32. | 0. | 66. | 1. | 2 | 23.13 | 1377.48 | -675.91 | 25. | -12. | 123. | 1. |
| 3 | 54.30 | 1371.79 | -1087.56 | 16. | -12. | 77. | 1. | 4 | 69.45 | 2506.60 | -407.54 | 15. | -2. | 41. | 1. |
| 5 | 86.70 | 3573.71 | -215.62 | 13. | -1. | 25. | 1. | 6 | 21.41 | 3806.59 | -4.03 | 10. | -0. | 18. | 1. |
| 7 | 15.00 | -1144.28 | 0.00 | -11. | 0. | 66. | 1. | 0 | 0.00 | 0.00 | 0.00 | 0. | 0. | 0. | 0. |

I = 3

| J | P | U(M) | W(M) | RE(T) | RE(R) | RE | CODE | J | P | U(M) | W(M) | RE(T) | RE(R) | RE | CODE |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 15.00 | 3350.13 | 0.00 | 44. | 0. | 100. | 1. | 2 | 24.26 | 141.12 | -42.33 | 4. | -1. | 193. | 1. |
| 3 | 52.93 | 879.77 | 260.50 | 14. | 4. | 118. | 1. | 4 | 65.55 | 2405.33 | 102.21 | 18. | 1. | 57. | 1. |
| 5 | 85.82 | 3955.27 | 5.50 | 17. | 0. | 32. | 1. | 6 | 17.44 | 4182.81 | 9.13 | 12. | 0. | 21. | 1. |
| 7 | 15.00 | -4695.85 | 0.00 | -62. | 0. | 100. | 1. | 0 | 0.00 | 0.00 | 0.00 | 0. | 0. | 0. | 0. |

I = 4

| J | P | U(M) | W(M) | RE(T) | RE(R) | RE | CODE | J | P | U(M) | W(M) | RE(T) | RE(R) | RE | CODE |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 15.00 | 3678.53 | 0.00 | 57. | 0. | 129. | 1. | 2 | 23.42 | -231.30 | 568.27 | -7. | 17. | 257. | 1. |
| 3 | 49.48 | 651.14 | 513.23 | 12. | 9. | 154. | 1. | 4 | 61.46 | 2320.96 | 107.58 | 20. | 1. | 72. | 1. |
| 5 | 85.28 | 4284.79 | -19.80 | 19. | -0. | 37. | 1. | 6 | 16.18 | 4496.84 | 3.53 | 12. | 0. | 22. | 1. |
| 7 | 15.00 | -6620.12 | 0.00 | -102. | 0. | 129. | 1. | 0 | 0.00 | 0.00 | 0.00 | 0. | 0. | 0. | 0. |

I = 5

| J | P | U(M) | W(M) | RE(T) | RE(R) | RE | CODE | J | P | U(M) | W(M) | RE(T) | RE(R) | RE | CODE |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 15.00 | 4269.84 | 0.00 | 69. | 0. | 147. | 1. | 2 | 21.58 | 467.53 | 1184.55 | 16. | 39. | 302. | 1. |
| 3 | 46.21 | 538.11 | 970.56 | 11. | 19. | 182. | 1. | 4 | 59.11 | 2210.86 | 147.92 | 20. | 1. | 82. | 1. |
| 5 | 80.36 | 4585.98 | -37.13 | 19. | -0. | 39. | 1. | 6 | 15.19 | 4792.45 | .90 | 11. | 0. | 21. | 1. |
| 7 | 15.00 | -7399.21 | 0.00 | -120. | 0. | 147. | 1. | 0 | 0.00 | 0.00 | 0.00 | 0. | 0. | 0. | 0. |

I = 6

| J | P | U(M) | W(M) | RE(T) | RE(R) | RE | CODE | J | P | U(M) | W(M) | RE(T) | RE(R) | RE | CODE |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 15.00 | 4937.22 | 0.00 | 77. | 0. | 155. | 1. | 2 | 18.62 | 2291.77 | 1605.18 | 76. | 53. | 326. | 1. |
| 3 | 38.67 | 951.99 | 2745.32 | 19. | 54. | 196. | 1. | 4 | 53.33 | 2321.22 | 753.45 | 20. | 7. | 86. | 1. |
| 5 | 94.52 | 4870.33 | 266.77 | 19. | 1. | 39. | 1. | 6 | 15.40 | 5090.28 | .15 | 9. | 0. | 18. | 1. |
| 7 | 15.00 | -5969.10 | 0.00 | -94. | 0. | 155. | 1. | 0 | 0.00 | 0.00 | 0.00 | 0. | 0. | 0. | 0. |

I = 7

| J | P | U(M) | W(M) | RE(T) | RE(R) | RE | CODE | J | P | U(M) | W(M) | RE(T) | RE(R) | RE | CODE |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 15.00 | 5321.85 | -.00 | 78. | -0. | 156. | 1. | 2 | 15.00 | 5321.85 | 1923.25 | 175. | 63. | 351. | 1. |
| 3 | 15.00 | 5321.85 | 4651.63 | 96. | 84. | 192. | 1. | 4 | 15.00 | 5321.85 | 1684.80 | 44. | 14. | 88. | 1. |
| 5 | 15.00 | 5321.85 | 644.36 | 18. | 2. | 37. | 1. | 6 | 15.00 | 5321.85 | .07 | 2. | 0. | 5. | 1. |
| 7 | 15.00 | 5321.85 | -.00 | 78. | -0. | 156. | 1. | 0 | 0.00 | 0.00 | 0.00 | 0. | 0. | 0. | 0. |

P = Pressure (psia)
U(M) = Tangential Flow Velocity (in./sec.)
W(M) = Radial Flow Velocity (in./sec.)
RE(T) = Tangential Local Reynolds Number
RE(R) = Radial Local Reynolds Number



692500

PROGRAM 119R (BOSS1).  4/ 9/73. CM=126000
* * SPECIAL VERSION **

STIFFN
END

FOIL THRUST BEARING-BOSS1 SOLUTION

7 NODES ARE SKEWED WRT X-Y PLANE

BOUNDARY CONDITIONS FOR 10 NODES

| NODE | FX OR UX | FY OR UY | FZ OR UZ | MX OR RX | MY OR RY | MZ OR RZ |
|---|---|---|---|---|---|---|
| 13 | 0. | 0. | -.2000E+01 | -0. | -0. | -0. |
| 14 | 0. | 0. | -.2000E+01 | -0. | -0. | -0. |
| 20 | 0. | 0. | -.2000E+01 | -0. | -0. | -0. |
| 21 | 0. | 0. | -.2000E+01 | -0. | -0. | -0. |
| 27 | 0. | 0. | -.2000E+01 | -0. | -0. | -0. |
| 28 | 0. | 0. | -.2000E+01 | -0. | -0. | -0. |
| 34 | 0. | 0. | -.2000E+01 | -0. | -0. | -0. |
| 35 | 0. | 0. | -.2000E+01 | -0. | -0. | -0. |
| 41 | 0. | 0. | -.2000E+01 | -0. | -0. | -0. |
| 42 | 0. | 0. | -.2000E+01 | -0. | -0. | -0. |

BOUNDARY CONDITIONS FOR 49 NODES

| NODE | FX OR UX | FY OR UY | FZ OR UZ | MX OR RX | MY OR RY | MZ OR RZ |
|---|---|---|---|---|---|---|
| 2 | -0. | -0. | 0. | -0. | -0. | -0. |
| 9 | -0. | -0. | 0. | -0. | -0. | -0. |
| 16 | -0. | -0. | 0. | -0. | -0. | -0. |
| 23 | -0. | -0. | 0. | -0. | -0. | -0. |
| 30 | -0. | -0. | 0. | -0. | -0. | -0. |
| 37 | -0. | -0. | 0. | -0. | -0. | -0. |
| 44 | -0. | -0. | 0. | -0. | -0. | -0. |
| 3 | -0. | -0. | 0. | -0. | -0. | -0. |
| 10 | -0. | -0. | .4694E+00 | -0. | -0. | -0. |
| 17 | -0. | -0. | .5945E+00 | -0. | -0. | -0. |
| 24 | -0. | -0. | .5956E+00 | -0. | -0. | -0. |
| 31 | -0. | -0. | .5082E+00 | -0. | -0. | -0. |
| 38 | -0. | -0. | .3024E+00 | -0. | -0. | -0. |
| 45 | -0. | -0. | 0. | -0. | -0. | -0. |
| 5 | -0. | -0. | 0. | -0. | -0. | -0. |
| 12 | -0. | -0. | .1757E+01 | -0. | -0. | -0. |
| 19 | -0. | -0. | .1886E+01 | -0. | -0. | -0. |
| 26 | -0. | -0. | .1888E+01 | -0. | -0. | -0. |
| 33 | -0. | -0. | .1865E+01 | -0. | -0. | -0. |
| 40 | -0. | -0. | .1534E+01 | -0. | -0. | -0. |
| 47 | -0. | -0. | 0. | -0. | -0. | -0. |
| 7 | -0. | -0. | 0. | -0. | -0. | -0. |
| 14 | -0. | -0. | .8614E+00 | -0. | -0. | -0. |
| 21 | -0. | -0. | .8900E+00 | -0. | -0. | -0. |
| 28 | -0. | -0. | .9007E+00 | -0. | -0. | -0. |
| 35 | -0. | -0. | .8336E+00 | -0. | -0. | -0. |
| 42 | -0. | -0. | .8796E+00 | -0. | -0. | -0. |
| 49 | -0. | -0. | 0. | -0. | -0. | -0. |
| 6 | -0. | -0. | 0. | -0. | -0. | -0. |
| 13 | -0. | -0. | .1135E+01 | -0. | -0. | -0. |
| 20 | -0. | -0. | .1247E+01 | -0. | -0. | -0. |
| 27 | -0. | -0. | .1363E+01 | -0. | -0. | -0. |



62500

| | | | | | |
|---|---|---|---|---|---|
| 34 | -0. | -0. | .1595E+01 | -0. | -0. | -0. |
| 41 | -0. | -0. | .1825E+01 | -0. | -0. | -0. |
| 48 | -0. | -0. | 0. | -0. | -0. | -0. |
| 4 | -0. | -0. | 0. | -0. | -0. | -0. |
| 11 | -0. | -0. | .2054E+00 | -0. | -0. | -0. |
| 18 | -0. | -0. | .8680E-01 | -0. | -0. | -0. |
| 25 | -0. | -0. | .4630E-01 | -0. | -0. | -0. |
| 32 | -0. | -0. | .8300E-02 | -0. | -0. | -0. |
| 39 | -0. | -0. | .1870E-01 | -0. | -0. | -0. |
| 46 | -0. | -0. | 0. | -0. | -0. | -0. |
| 2 | -0. | -0. | 0. | -0. | -0. | -0. |
| 9 | -0. | -0. | 0. | -0. | -0. | -0. |
| 16 | -0. | -0. | 0. | -0. | -0. | -0. |
| 23 | -0. | -0. | 0. | -0. | -0. | -0. |
| 30 | -0. | -0. | 0. | -0. | -0. | -0. |
| 37 | -0. | -0. | 0. | -0. | -0. | -0. |
| 44 | -0. | -0. | 0. | -0. | -0. | -0. |

NN= 8

LOCAL COORDINATES OF ELEMENT 5 FOR NODES MARKED **LOCAL** N
SEE LATER PRINT-OUT FOR GLOBAL

PASS 1 COMPLETED



62500

FOIL THRUST BEARING-ROSS1 SOLUTION

GLOBAL DEFLECTIONS (IN) AND ROTATIONS (RADIANS)--

| NODE | UX | UY | UZ | THETA X | THETA Y | THETA Z |
|---|---|---|---|---|---|---|
| 1 | 0.00000000 | 0.00000000 | .00038198 | .00142966 | -.00213412 | 0.00000000 |
| 2 | 0.00000000 | 0.00000000 | .00038198 | .00027414 | -.00255406 | 0.00000000 |
| 3 | 0.00000000 | 0.00000000 | .00072459 | .00227113 | -.00140076 | 0.00000000 |
| 4 | 0.00000000 | 0.00000000 | .00012617 | .00020337 | -.00021418 | 0.00000000 |
| 5 | 0.00000000 | 0.00000000 | .00048856 | .00174463 | .00223054 | 0.00000000 |
| 6 | 0.00000000 | 0.00000000 | .00019529 | .00116756 | .00168191 | 0.00000000 |
| 7 | 0.00000000 | 0.00000000 | .00030028 | .00133686 | .00182159 | 0.00000000 |
| 8 | 0.00000000 | 0.00000000 | .00068958 | .00124782 | -.00340924 | 0.00000000 |
| 9 | 0.00000000 | 0.00000000 | .00068958 | -.00047984 | -.00359863 | 0.00000000 |
| 10 | 0.00000000 | 0.00000000 | .00128538 | .00240057 | -.00173783 | 0.00000000 |
| 11 | 0.00000000 | 0.00000000 | .00014737 | -.00031440 | -.00049891 | 0.00000000 |
| 12 | 0.00000000 | 0.00000000 | .00080377 | .00254041 | .00390203 | 0.00000000 |
| 13 | 0.00000000 | 0.00000000 | .00125780 | .00088705 | .00233412 | 0.00000000 |
| 14 | 0.00000000 | 0.00000000 | .00042329 | .00164845 | .00295159 | 0.00000000 |
| 15 | 0.00000000 | 0.00000000 | .00093691 | .00091613 | -.00460741 | 0.00000000 |
| 16 | 0.00000000 | 0.00000000 | .00093691 | -.00132995 | -.00450541 | 0.00000000 |
| 17 | 0.00000000 | 0.00000000 | .00181202 | .00195906 | -.00216380 | 0.00000000 |
| 18 | 0.00000000 | 0.00000000 | .00019008 | -.00050989 | -.00063102 | 0.00000000 |
| 19 | 0.00000000 | 0.00000000 | .00110200 | .00259554 | .00529908 | 0.00000000 |
| 20 | 0.00000000 | 0.00000000 | .00029104 | .00107394 | .00306043 | 0.00000000 |
| 21 | 0.00000000 | 0.00000000 | .00053261 | .00197211 | .00397987 | 0.00000000 |
| 22 | 0.00000000 | 0.00000000 | .00109214 | .00044212 | -.00531912 | 0.00000000 |
| 23 | 0.00000000 | 0.00000000 | .00109214 | -.00208042 | -.00491532 | 0.00000000 |
| 24 | 0.00000000 | 0.00000000 | .00218874 | .00109956 | -.00245354 | 0.00000000 |
| 25 | 0.00000000 | 0.00000000 | .00017976 | -.00068708 | -.00066743 | 0.00000000 |
| 26 | 0.00000000 | 0.00000000 | .00130891 | .00236856 | .00613414 | 0.00000000 |
| 27 | 0.00000000 | 0.00000000 | .00030723 | .00104347 | .00353658 | 0.00000000 |
| 28 | 0.00000000 | 0.00000000 | .00060851 | .00194761 | .00459812 | 0.00000000 |
| 29 | 0.00000000 | 0.00000000 | .00114418 | -.00000623 | -.00544319 | 0.00000000 |
| 30 | 0.00000000 | 0.00000000 | .00114418 | -.00253507 | -.00481682 | 0.00000000 |
| 31 | 0.00000000 | 0.00000000 | .00235641 | .00008125 | -.00252520 | 0.00000000 |
| 32 | 0.00000000 | 0.00000000 | .00015501 | -.00072169 | -.00066555 | 0.00000000 |
| 33 | 0.00000000 | 0.00000000 | .00141706 | .00189597 | .00639050 | 0.00000000 |
| 34 | 0.00000000 | 0.00000000 | .00029610 | .00094382 | .00363765 | 0.00000000 |
| 35 | 0.00000000 | 0.00000000 | .00063487 | .00171927 | .00478391 | 0.00000000 |
| 36 | 0.00000000 | 0.00000000 | .00111194 | -.00027052 | -.00523901 | 0.00000000 |
| 37 | 0.00000000 | 0.00000000 | .00111194 | -.00267420 | -.00451321 | 0.00000000 |
| 38 | 0.00000000 | 0.00000000 | .00234167 | -.00037928 | -.00235441 | 0.00000000 |
| 39 | 0.00000000 | 0.00000000 | .00012748 | -.00066245 | -.00048398 | 0.00000000 |
| 40 | 0.00000000 | 0.00000000 | .00140132 | .00120550 | .00607940 | 0.00000000 |
| 41 | 0.00000000 | 0.00000000 | .00027901 | .00087952 | .00330927 | 0.00000000 |
| 42 | 0.00000000 | 0.00000000 | .00091480 | .00153098 | .00442818 | 0.00000000 |
| 43 | 0.00000000 | 0.00000000 | .00103733 | -.00045813 | -.00559486 | 0.00000000 |
| 44 | 0.00000000 | 0.00000000 | .00103733 | -.00300569 | -.00474112 | 0.00000000 |
| 45 | 0.00000000 | 0.00000000 | .00233937 | .00024798 | -.00183755 | 0.00000000 |
| 46 | 0.00000000 | 0.00000000 | .00002287 | -.00087474 | .00043899 | 0.00000000 |
| 47 | 0.00000000 | 0.00000000 | .00127845 | .00077838 | .00552576 | 0.00000000 |
| 48 | 0.00000000 | 0.00000000 | .00024177 | .00066767 | .00333803 | 0.00000000 |
| 49 | 0.00000000 | 0.00000000 | .00058500 | .00125168 | .00398268 | 0.00000000 |

LOCAL COORDINATES OF ELEMENT N FOR NODES MARKED **LOCAL** N
SEE LATER PRINT-OUT FOR GLOBAL



82500

FOIL THRUST BEARING-HOSS1 SOLUTION

| ELEM | CENTER OF ELEMENT (GLOBAL COORDS) X | Y | Z | STRESSES ARE CALCULATED IN THE LOCAL (ELEMENT) COORDINATE SYSTEM: AT Z= +T/2 SIG X | SIG Y | TAU XY | MAX | MIN | ANGLE | EQUIV. | AT Z= -T/2 SIG X | SIG Y | TAU XY | MAX | MIN | ANGLE | EQUIV. | (--AT Z=0--) TAUXZ | TAUYZ |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | .060 | 1.821 | 0.000 | -.5 | 4.5 | -.5 | 4.5 | -.6 | -84.1 | 4.9 | .5 | -4.5 | .5 | .6 | -4.5 | 5.9 | 4.9 | -.0 | -.7 |
| 2 | .124 | 1.891 | 0.000 | -3.5 | 3.7 | 1.7 | 4.0 | -3.9 | 77.5 | 6.8 | 3.5 | -3.7 | -1.7 | 3.9 | -4.0 | -12.5 | 6.8 | .4 | -1.8 |
| 3 | .280 | 1.797 | 0.000 | 3.7 | 2.4 | -2.6 | 5.7 | .4 | -37.8 | 5.5 | -3.7 | -2.4 | 2.6 | -.4 | -5.7 | 52.2 | 5.5 | -.3 | .5 |
| 4 | .342 | 1.851 | 0.000 | .5 | -5.7 | -.3 | .5 | -5.7 | -2.5 | 5.9 | -.5 | 5.7 | .3 | 5.7 | -.5 | 87.5 | 5.9 | 1.1 | -.6 |
| 5 | .501 | 1.753 | 0.000 | -.3 | -5.7 | 1.6 | .1 | -6.1 | 15.4 | 6.2 | .3 | 5.7 | -1.6 | 6.1 | -.1 | -74.6 | 6.2 | .4 | .1 |
| 6 | .547 | 1.816 | 0.000 | .6 | -7.2 | 2.0 | 1.1 | -7.7 | 13.4 | 8.3 | -.6 | 7.2 | -2.0 | 7.7 | -1.1 | -76.6 | 8.3 | .8 | -.3 |
| 7 | .593 | 1.802 | 0.000 | -.2 | -4.9 | 1.7 | .4 | -5.5 | 17.8 | 5.7 | .2 | 4.9 | -1.7 | 5.5 | -.4 | -72.2 | 5.7 | .6 | -.3 |
| 8 | .596 | 1.727 | 0.000 | -.5 | -2.6 | 1.4 | .2 | -3.3 | 27.0 | 3.4 | .5 | 2.6 | -1.4 | 3.3 | -.2 | -63.0 | 3.4 | .5 | -.4 |
| 9 | .653 | 1.781 | 0.000 | -2.3 | -4.3 | 2.1 | -1.0 | -5.6 | 31.9 | 5.2 | 2.3 | 4.3 | -2.1 | 5.6 | 1.0 | -58.1 | 5.2 | .2 | -.0 |
| 10 | .653 | 1.702 | 0.000 | -1.6 | -.7 | .4 | -.6 | -1.7 | 69.3 | 1.5 | 1.6 | .7 | -.4 | 1.7 | .6 | -20.7 | 1.5 | .1 | .1 |
| 11 | .745 | 1.733 | 0.000 | -4.3 | -1.5 | 2.6 | .0 | -5.9 | 59.2 | 5.9 | 4.3 | 1.5 | -2.6 | 5.9 | -.0 | -30.8 | 5.9 | .2 | -.7 |
| 12 | .793 | 1.640 | 0.000 | -1.1 | 1.2 | -1.4 | 1.8 | -1.7 | -64.6 | 3.1 | 1.1 | -1.2 | 1.4 | 1.7 | -1.8 | 25.4 | 3.1 | -.3 | .5 |
| 13 | .048 | 2.041 | 0.000 | -.6 | 6.2 | -.3 | 6.2 | -.6 | -87.1 | 6.5 | .6 | -6.2 | .3 | .6 | -6.2 | 2.9 | 6.5 | .1 | -1.2 |
| 14 | .143 | 2.111 | 0.000 | -4.5 | 5.5 | 1.7 | 5.8 | -4.7 | 80.7 | 9.1 | 4.5 | -5.5 | -1.7 | 4.7 | -5.8 | -9.3 | 9.1 | .3 | -2.1 |
| 15 | .315 | 2.015 | 0.000 | 6.4 | 5.3 | -4.2 | 10.1 | 1.6 | -41.1 | 9.4 | -6.4 | -5.3 | 4.2 | -1.6 | -10.1 | 48.9 | 9.4 | -.5 | .8 |
| 16 | .447 | 2.066 | 0.000 | .8 | -7.8 | -.6 | .9 | -7.9 | -3.7 | 8.3 | -.8 | 7.8 | .6 | 7.9 | -.9 | 86.3 | 8.3 | 1.3 | -.3 |
| 17 | .541 | 1.966 | 0.000 | -.3 | -7.5 | 2.0 | .2 | -8.0 | 14.6 | 8.1 | .3 | 7.5 | -2.0 | 8.0 | -.2 | -75.4 | 8.1 | .5 | .2 |
| 18 | .611 | 2.028 | 0.000 | 1.1 | -9.7 | 2.4 | 1.6 | -10.2 | 11.8 | 11.1 | -1.1 | 9.7 | -2.4 | 10.2 | -1.6 | -78.2 | 11.1 | 1.1 | -.2 |
| 19 | .662 | 2.012 | 0.000 | -.5 | -6.7 | 2.2 | .2 | -7.4 | 17.5 | 7.5 | .5 | 6.7 | -2.2 | 7.4 | -.2 | -72.5 | 7.5 | .7 | -.3 |
| 20 | .697 | 1.936 | 0.000 | -1.3 | -4.7 | 2.1 | -.3 | -5.7 | 25.6 | 5.5 | 1.3 | 4.7 | -2.1 | 5.7 | .3 | -64.4 | 5.5 | .6 | -.5 |
| 21 | .729 | 1.988 | 0.000 | -2.9 | -5.7 | 2.4 | -1.5 | -7.0 | 29.9 | 6.4 | 2.9 | 5.7 | -2.4 | 7.0 | 1.5 | -60.1 | 6.4 | .2 | .1 |
| 22 | .732 | 1.909 | 0.000 | -2.5 | -1.8 | .6 | -1.5 | -2.9 | 60.2 | 2.5 | 2.5 | 1.8 | -.6 | 2.9 | 1.5 | -29.8 | 2.5 | .1 | .1 |
| 23 | .854 | 1.936 | 0.000 | -5.5 | -2.6 | 3.4 | -.4 | -7.7 | 56.8 | 7.5 | 5.5 | 2.6 | -3.4 | 7.7 | .4 | -33.2 | 7.5 | .3 | -.9 |
| 24 | .883 | 1.839 | 0.000 | -1.4 | .4 | -1.3 | 1.2 | -2.1 | -62.5 | 2.9 | 1.4 | -.4 | 1.3 | 2.1 | -1.2 | 27.5 | 2.9 | -.3 | .7 |
| 25 | .075 | 2.261 | 0.000 | -.8 | 7.0 | .2 | 7.0 | -.8 | 86.2 | 7.4 | .8 | -7.0 | -.2 | .8 | -7.0 | -1.8 | 7.4 | .2 | -1.7 |
| 26 | .158 | 2.330 | 0.000 | -4.8 | 7.4 | 1.3 | 7.6 | -4.9 | 83.9 | 10.9 | 4.8 | -7.4 | -1.3 | 4.9 | -7.6 | -6.1 | 10.9 | .1 | -2.2 |
| 27 | .348 | 2.232 | 0.000 | 8.9 | 7.9 | -5.7 | 14.1 | 2.7 | -42.4 | 13.0 | -8.9 | -7.9 | 5.7 | -2.7 | -14.1 | 47.6 | 13.0 | -.7 | 1.1 |
| 28 | .483 | 2.281 | 0.000 | 1.2 | -9.0 | -1.1 | 1.4 | -9.1 | -6.2 | 9.8 | -1.2 | 9.0 | 1.1 | 9.1 | -1.4 | 83.8 | 9.8 | 1.4 | .1 |
| 29 | .622 | 2.178 | 0.000 | -.2 | -8.3 | 1.9 | .3 | -8.7 | 12.7 | 8.9 | .2 | 8.3 | -1.9 | 8.7 | -.3 | -77.3 | 8.9 | .7 | .4 |
| 30 | .675 | 2.239 | 0.000 | 1.3 | -11.4 | 2.6 | 1.8 | -12.0 | 11.2 | 13.0 | -1.3 | 11.4 | -2.6 | 12.0 | -1.8 | -78.8 | 13.0 | 1.2 | .0 |
| 31 | .731 | 2.222 | 0.000 | -.9 | -7.9 | 2.4 | -.1 | -8.7 | 17.3 | 8.7 | .9 | 7.9 | -2.4 | 8.7 | .1 | -72.7 | 8.7 | .8 | -.3 |
| 32 | .728 | 2.145 | 0.000 | -1.7 | -5.6 | 2.5 | -.5 | -6.8 | 25.7 | 6.5 | 1.7 | 5.6 | -2.5 | 6.8 | .5 | -64.3 | 6.5 | .8 | -.6 |
| 33 | .805 | 2.195 | 0.000 | -3.5 | -6.7 | 2.7 | -2.0 | -8.3 | 29.6 | 7.5 | 3.5 | 6.7 | -2.7 | 8.3 | 2.0 | -60.4 | 7.5 | .3 | .1 |
| 34 | .811 | 2.115 | 0.000 | -3.3 | -2.5 | .8 | -2.0 | -3.9 | 57.7 | 3.3 | 3.3 | 2.5 | -.8 | 3.9 | 2.0 | -32.3 | 3.3 | .2 | .1 |
| 35 | .943 | 2.137 | 0.000 | -6.3 | -3.8 | 4.0 | -.8 | -9.2 | 53.6 | 8.8 | 6.3 | 3.8 | -4.0 | 9.2 | .8 | -36.4 | 8.8 | .4 | -1.1 |
| 36 | .984 | 2.038 | 0.000 | -2.0 | -.8 | -.9 | -.3 | -2.5 | -62.1 | 2.3 | 2.0 | .8 | .9 | 2.5 | .3 | 27.9 | 2.3 | -.2 | .8 |
| 37 | .084 | 2.481 | 0.000 | -1.2 | 6.5 | 1.0 | 6.6 | -1.3 | 82.9 | 7.3 | 1.2 | -6.5 | -1.0 | 1.3 | -6.6 | -7.1 | 7.3 | .3 | -2.1 |
| 38 | .173 | 2.550 | 0.000 | -4.6 | 8.7 | .7 | 8.7 | -4.7 | 86.8 | 11.8 | 4.6 | -8.7 | -.7 | 4.7 | -8.7 | -3.2 | 11.8 | -.2 | -2.0 |
| 39 | .383 | 2.449 | 0.000 | 10.6 | 9.9 | -6.7 | 16.9 | 3.5 | -43.5 | 15.5 | -10.6 | -9.9 | 6.7 | -3.5 | -16.9 | 46.5 | 15.5 | -.8 | 1.3 |
| 40 | .530 | 2.496 | 0.000 | 1.5 | -9.2 | -1.5 | 1.8 | -9.4 | -8.0 | 10.4 | -1.5 | 9.2 | 1.5 | 9.4 | -1.8 | 82.0 | 10.4 | 1.4 | .4 |
| 41 | .483 | 2.390 | 0.000 | .0 | -8.5 | 1.7 | .4 | -8.8 | 10.7 | 9.0 | -.0 | 8.5 | -1.7 | 8.8 | -.4 | -79.3 | 9.0 | .7 | .5 |
| 42 | .739 | 2.450 | 0.000 | 1.5 | -12.1 | 2.5 | 1.9 | -12.5 | 10.2 | 13.6 | -1.5 | 12.1 | -2.5 | 12.5 | -1.9 | -79.8 | 13.6 | 1.2 | .3 |
| 43 | .799 | 2.431 | 0.000 | -1.1 | -8.3 | 2.4 | -.3 | -9.0 | 16.8 | 8.8 | 1.1 | 8.3 | -2.4 | 9.0 | .3 | -73.2 | 8.8 | .8 | -.1 |
| 44 | .799 | 2.354 | 0.000 | -1.9 | -6.1 | 2.5 | -.7 | -7.3 | 25.1 | 6.9 | 1.9 | 6.1 | -2.5 | 7.3 | .7 | -64.9 | 6.9 | .9 | -.6 |
| 45 | .881 | 2.402 | 0.000 | -3.8 | -7.1 | 2.8 | -2.3 | -8.7 | 29.6 | 7.8 | 3.8 | 7.1 | -2.8 | 8.7 | 2.3 | -60.4 | 7.8 | .3 | .2 |
| 46 | .890 | 2.321 | 0.000 | -3.9 | -3.1 | 1.0 | -2.5 | -4.5 | 55.2 | 3.9 | 3.9 | 3.1 | -1.0 | 4.5 | 2.5 | -34.8 | 3.9 | .2 | .1 |
| 47 | 1.032 | 2.339 | 0.000 | -6.4 | -4.6 | 4.2 | -1.2 | -9.4 | 51.0 | 9.3 | 6.4 | 4.6 | -4.2 | 9.9 | 1.2 | -39.0 | 9.3 | .5 | -1.1 |
| 48 | 1.081 | 2.236 | 0.000 | -2.4 | -2.1 | -.3 | -1.9 | -2.6 | -55.3 | 2.3 | 2.4 | 2.1 | .3 | 2.6 | 1.9 | 34.7 | 2.3 | -.1 | .8 |
| 49 | .090 | 2.702 | 0.000 | -1.7 | 5.1 | 1.6 | 5.4 | -2.0 | 77.4 | 6.7 | 1.7 | -5.1 | -1.6 | 2.0 | -5.4 | -12.6 | 6.7 | .4 | -2.2 |
| 50 | .189 | 2.771 | 0.000 | -4.1 | 9.4 | .1 | 9.4 | -4.1 | 89.6 | 12.0 | 4.1 | -9.4 | -.1 | 4.1 | -9.4 | -.4 | 12.0 | -.3 | -1.8 |



62500

FOIL THRUST BEARING-ROSSI SOLUTION

STRESSES ARE CALCULATED IN THE LOCAL (FLEMENT) COORDINATE SYSTEM

| ELEM | CENTER OF ELEMENT (GLOBAL COORDS) X | Y | Z | AT Z= +T/2 SIG X | SIG Y | TAU XY | MAX | MIN | ANGLE | EQUIV. | AT Z= -T/2 SIG X | SIG Y | TAU XY | MAX | MIN | ANGLE | EQUIV. | AT Z=0 TAUXZ | TAUYZ |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 51 | .418 | 2.667 | 0.000 | 10.9 | 10.1 | -7.0 | 17.5 | 3.5 | -43.4 | 16.0 | -10.9 | -10.1 | 7.0 | -3.5 | -17.5 | 46.6 | 16.0 | -.8 | 1.3 |
| 52 | .576 | 2.712 | 0.000 | 1.4 | -9.1 | -1.8 | 1.7 | -9.4 | -9.3 | 10.4 | -1.4 | 9.1 | 1.8 | 9.4 | -1.7 | 80.7 | 10.4 | 1.2 | .7 |
| 53 | .743 | 2.602 | 0.000 | .3 | -7.8 | 1.2 | .5 | -8.0 | 8.3 | 8.2 | -.3 | 7.8 | -1.2 | 8.0 | -.5 | -81.7 | 8.2 | .7 | .6 |
| 54 | .802 | 2.661 | 0.000 | 1.5 | -11.3 | 2.2 | 1.9 | -11.7 | 9.4 | 12.7 | -1.5 | 11.3 | -2.2 | 11.7 | -1.9 | -80.6 | 12.7 | 1.1 | .5 |
| 55 | .868 | 2.641 | 0.000 | -1.4 | -7.9 | 2.2 | -.7 | -8.5 | 16.9 | 8.2 | 1.4 | 7.9 | -2.2 | 8.5 | .7 | -73.1 | 8.2 | .8 | -.1 |
| 56 | .870 | 2.563 | 0.000 | -2.0 | -6.0 | 2.3 | -1.0 | -7.1 | 24.1 | 6.6 | 2.0 | 6.0 | -2.3 | 7.1 | 1.0 | -65.9 | 6.6 | .9 | -.6 |
| 57 | .957 | 2.610 | 0.000 | -3.7 | -7.0 | 2.5 | -2.4 | -8.3 | 28.6 | 7.4 | 3.7 | 7.0 | -2.5 | 8.3 | 2.4 | -61.4 | 7.4 | .3 | .2 |
| 58 | .963 | 2.527 | 0.000 | -4.0 | -3.4 | 1.0 | -2.6 | -4.8 | 52.7 | 4.1 | 4.0 | 3.4 | -1.0 | 4.8 | 2.6 | -37.3 | 4.1 | .2 | .1 |
| 59 | 1.121 | 2.541 | 0.000 | -6.2 | -5.0 | 4.3 | -1.3 | -9.9 | 49.0 | 9.3 | 6.2 | 5.0 | -4.3 | 9.9 | 1.3 | -41.0 | 9.3 | .5 | -1.1 |
| 60 | 1.176 | 2.434 | 0.000 | -2.5 | -3.1 | .1 | -2.5 | -3.1 | 10.4 | 2.9 | 2.5 | 3.1 | -.1 | 3.1 | 2.5 | -79.6 | 2.9 | -.0 | .7 |
| 61 | .098 | 2.923 | 0.000 | -1.9 | 4.5 | 1.5 | 4.8 | -2.2 | 77.1 | 6.2 | 1.9 | -4.5 | -1.5 | 2.2 | -4.8 | -12.9 | 6.2 | .5 | -2.2 |
| 62 | .284 | 2.991 | 0.000 | -3.9 | 10.1 | -.2 | 10.1 | -3.9 | -89.3 | 12.5 | 3.9 | -10.1 | .2 | 3.9 | -10.1 | .7 | 12.5 | -.2 | -2.1 |
| 63 | .452 | 2.884 | 0.000 | 10.1 | 8.0 | -6.6 | 15.7 | 2.4 | -40.7 | 14.7 | -10.1 | -8.0 | 6.6 | -2.4 | -15.7 | 49.3 | 14.7 | -.8 | 1.4 |
| 64 | .522 | 2.927 | 0.000 | 1.3 | -9.7 | -2.1 | 1.7 | -10.1 | -10.3 | 11.0 | -1.3 | 9.7 | 2.1 | 10.1 | -1.7 | 79.7 | 11.0 | 1.0 | 1.0 |
| 65 | .804 | 2.814 | 0.000 | .3 | -6.7 | .8 | .6 | -6.8 | 6.8 | 7.0 | -.3 | 6.7 | -.8 | 6.8 | -.4 | -83.2 | 7.0 | .6 | .5 |
| 66 | .866 | 2.873 | 0.000 | 1.4 | -10.1 | 2.0 | 1.7 | -10.5 | 9.4 | 11.4 | -1.4 | 10.1 | -2.0 | 10.5 | -1.7 | -80.6 | 11.4 | 1.0 | .5 |
| 67 | .937 | 2.851 | 0.000 | -.9 | -7.1 | 1.7 | -.4 | -7.5 | 14.4 | 7.3 | .9 | 7.1 | -1.7 | 7.5 | .4 | -75.6 | 7.3 | .7 | .0 |
| 68 | .941 | 2.772 | 0.000 | -1.8 | -5.4 | 2.2 | -.8 | -6.4 | 25.3 | 6.1 | 1.8 | 5.4 | -2.2 | 6.4 | .8 | -64.7 | 6.1 | .8 | -.6 |
| 69 | 1.033 | 2.817 | 0.000 | -2.3 | -6.4 | 1.9 | -1.6 | -7.2 | 21.5 | 6.5 | 2.3 | 6.4 | -1.9 | 7.2 | 1.6 | -68.5 | 6.5 | .2 | .4 |
| 70 | 1.048 | 2.733 | 0.000 | -3.4 | -2.9 | 1.4 | -1.8 | -4.6 | 50.2 | 4.0 | 3.4 | 2.9 | -1.4 | 4.6 | 1.8 | -39.8 | 4.0 | .2 | .0 |
| 71 | 1.210 | 2.743 | 0.000 | -6.4 | -5.4 | 4.7 | -1.2 | -10.6 | 48.1 | 10.1 | 6.4 | 5.4 | -4.7 | 10.6 | 1.2 | -41.9 | 10.1 | .4 | -1.0 |
| 72 | 1.271 | 2.633 | 0.000 | -2.4 | -3.0 | .1 | -2.4 | -3.0 | 5.2 | 2.8 | 2.4 | 3.0 | -.1 | 3.0 | 2.4 | -84.8 | 2.8 | .0 | .7 |

STRESSES IN KSI, ANGLES IN DEGREES

CONVERGED WITHIN 1.00 PERCENT



62500

Preceding Page BLANK - NOT FILMed

# APPENDIX A

## JOURNAL BEARING STATIC ELASTICITY PROGRAM LISTING

(53 PAGES)



62500

```
      OVERLAY(ISOFB1,0,0)                                                    CURBM      2
      PROGRAM CURBM (INPUT=65,OUTPUT=65,TAPE60=INPUT,TAPE61=OUTPUT,          CURBM      3
     + TAPE3=65,TAPE4=65,TAPE7=65,TAPE13=65,TAPE15=65,TAPE10=65,TAPE20=6     CURBM      4
     +5,TAPE6,TAPE17=65,TAPE19=65)                                           CURBM      5
      COMMON /IZO/ IN,IOUT                                                   CURBM      6
      COMMON/NSX/MS,LUZ                                                      CURBM      7
      COMMON/SYMSOL/NN,MM,NNPE,NDOF,NVECT,LUT,LUK,LUE,LUR,INDEX3(41),IND     CURBM      8
     +EX7(146)                                                               CURBM      9
      COMMON/CURBM//TITLE(8),ICM(30),ENOA(160),NB(145,2),SM(3,3),SMT(3,3     CURBM     10
     +),SMS(6,6),S(6,6)                                                      CURBM     11
      COMMON NODES,NELEM,NW                                                  CURBM     12
     +,PRE(11)                                                               CURBM     13
      COMMON /DEFLEC/ SPACE(30)                                              CURBM     14
      COMMON/FOILLY/IFOIL,NODFL,N,M,N1,N2,M1,M2                              CURBM     15
      COMMON/RT/RS1,RB,RO,T,RFF,RL                                           CURBM     16
      COMMON/L/AL,TC                                                         CURBM     17
      COMMON/PLOTQ/IPLOT,NPLOT,IPRINT,MPRINT                                 DH4/23     1
      DATA IN,IOUT/60,61/                                                    CURBM     19
      DATA LUT,LUK,LUE,LUR,LUZ/3,4,7,13,15/                                  CURBM     20
      CALL OPENMS (LUE,INDEX7,146,0)                                         CURBM     21
      CALL OPENMS(LUT,INDEX3,41,0)                                           CURBM     22
      READ(60,4)(TITLE(I),I=1,8)                                             DH4/23     2
      READ(60,5)RFOIL,RNOD,RB,AL,T,TC,RL,RFF                                 CURBM     23
      READ(60,6)IPLOT,IPRINT,MPRINT                                          DH4/23     3
      IF(EOF(60))20,30                                                       CURBM     25
   20 IPLOT=0                                                                CURBM     26
   30 CONTINUE                                                               CURBM     27
      WRITE(61,10)TITLE                                                      DH4/23     4
   10 FORMAT(1H1,8A10,/,132(1H*))                                            DH4/23     5
      WRITE(61,11)                                                           CURBM     30
   11 FORMAT(1H0,*NO. OF FOILS   NODES/FOIL   BEARING RADIUS*                CURBM     31
     +*   AXIAL LENGTH   FOIL THICKNESS   COATING THICKNESS   *              CURBM     32
     +*FOIL ARCLENGTH   FREE FOIL R*)                                        CURBM     33
      IFOIL=RFOIL                                                            CURBM     34
      NODFL=RNOD                                                             CURBM     35
      WRITE(61,12)IFOIL,NODFL,RB,AL,T,TC,RL,RFF                              CURBM     36
      WRITE(61,13)                                                           CURBM     37
      CALL OVERLAY(6HISOFB1,1,0)                                             CURBM     38
      CALL OVERLAY(6HISOFB1,6,0)                                             CURBM     39
   12 FORMAT(1H ,4X,I2,14X,I2,10X,2(F9.5,7X),F9.5,8X,F9.5,11X,F9.5           CURBM     40
     +,8X,F9.5)                                                              CURBM     41
   13 FORMAT(1H0,132(1H*))                                                   CURBM     42
    5 FORMAT(8F10.5)                                                         CURBM     43
    6 FORMAT(3I5)                                                            DH4/23     6
    4 FORMAT(8A10)                                                           DH4/23     7
      END                                                                    CURBM     45
```



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1                SUBROUTINE PACK60 (J,N,I)                                  PACK60   2
           C     ENTRY POINTS PACK60 AND UNPCK60                            PACK60   3
           C                                                                PACK60   4
                 DIMENSION LAB(2), MASKS(2)                                 PACK60   5
5                DATA LAB / 6HPACK60 , 7HUNPCK60  /                         PACK60   6
                 DATA MASKS(1) / 77777777777777777776B  /                   PACK60   7
                 DATA MASKS(2) / 00000000000000000001B  /                   PACK60   8
           C                                                                PACK60   9
           C     STORE N INTO J IN THE I(TH) POSITION                       PACK60  10
10         C     N= 0  OR  N=1  OR N=-0                                     PACK60  11
           C     MINUS ZERO IS TREATED AS PLUS ZERO                         PACK60  12
           C          0 .LT. I .LT. 61                                      PACK60  13
           C     EACH POSITION IN J FOR THE INTEGER N IS ONE BIT            PACK60  14
           C     POSITION 1 IS THE HIGH ORDER BIT (BIT 59)                  PACK60  15
15         C     POSITION 60 IS THE LOW ORDER BIT (BIT 0)                   PACK60  16
           C                                                                PACK60  17
                 K= 1                                                       PACK60  18
                 IF (N .NE. 0 .AND. N .NE. 1) GO TO 50                      PACK60  19
              10 IF (I .GT. 0 .AND . I .LE. 60) GO TO 100                   PACK60  20
20            50 PRINT 1000, LAB(K), J, N, I                                PACK60  21
                 CALL EXIT                                                  PACK60  22
           C     SHIFT J  SO BIT IS IN LOW ORDER POSITION                   PACK60  23
             100 L= SHIFT ( J , I )                                         PACK60  24
           C     USE MASK TO ZERO THE BIT (PACK)                            PACK60  25
25         C     USE MASK TO ZERO THE OTHER 59 BITS (UNPACK)                PACK60  26
                 L= AND (L, MASKS(K) )                                      PACK60  27
                 IF (K .EQ. 2) GO TO 200                                    PACK60  28
           C     CHECK FOR MINUS ZERO                                       PACK60  29
                 M= N                                                       PACK60  30
30               IF (N .EQ. 0) M= 0                                         PACK60  31
           C     STORE N INTO WORD AND SHIFT BACK INTO PROPER POSITION FOR J PACK60  32
                 J= SHIFT ( L+M , 60 - I )                                  PACK60  33
                 RETURN                                                     PACK60  34
           C                                                                PACK60  35
35         C                                                                PACK60  36
                 ENTRY UNPCK60                                              PACK60  37
           C                                                                PACK60  38
           C                                                                PACK60  39
           C     UNPACK N FROM WORD J, I(TH) POSITION                       PACK60  40
40         C     SEE COMMENTS ABOVE                                         PACK60  41
                 K= 2                                                       PACK60  42
                 GO TO 10                                                   PACK60  43
             200 N= L                                                       PACK60  44
                 RETURN                                                     PACK60  45
45         C                                                                PACK60  46
            1000 FORMAT (13H0BAD CALL TO   ,A7, 15H, ARGS(OCTAL)=   3030 )  PACK60  47
                 END                                                        PACK60  48
```



0 2 5 0 0

```
      OVERLAY(ISOFR1,1,0)                                                MAIN1      2
      PROGRAM MAIN1                                                      MAIN1      3
      COMMON /IZO/ IN,IOUT                                               MAIN1      4
      COMMON/SYMSOL/NN,MM,NNPE,NDOF,NVECT,LUT,LUK,LUE,LUR,INDEX3(41),IND MAIN1      5
     +EX7(146)                                                           MAIN1      6
      COMMON/CURRMZ/TITLE(8),ICM(30),FNOA(160),NR(145,2),SM(3,3),SMT(3,3 MAIN1      7
     +),SMS(6,6),S(6,6)                                                  MAIN1      8
      COMMON /NSX/ NS                                                    MAIN1      9
      COMMON NODES,NELEM,NW,                                             MAIN1     10
     +PHE(11)                                                            MAIN1     11
      COMMON /FOILLY/ IFOIL,NODFL                                        MAIN1     12
      COMMON/L/AL,TC                                                     MAIN1     13
      COMMON/RT/RK,RB,R0,T,REF,RL                                        MAIN1     14
      DIMENSION TRAE(9),TRRE(9)                                          MAIN1     15
      DIMENSION IRC(3)                                                   MAIN1     16
      DIMENSION ALPHA(11)                                                MAIN1     17
      DIMENSION FORCE(3)                                                 MAIN1     18
      EQUIVALENCE (TRAE(1),SM(1,1)),(TRRE(1),SMT(1,1))                   MAIN1     19
      DATA IN/60/,IOUT/61/                                               MAIN1     20
      NDOF=3                                                             MAIN1     25
      NNPE=2                                                             MAIN1     26
      RK=RB                                                              MAIN1     28
      R=RK                                                               MAIN1     29
      READ(60,8)YM                                                       DH4/23     8
      THETA=(RL/RK)*180./3.14159                                         MAIN1     31
      IEND=0                                                             MAIN1     32
      IFOR=0                                                             MAIN1     33
      IDEL=0                                                             MAIN1     34
      NODES=IFOIL*NODFL                                                  MAIN1     35
      NODFL2=NODFL/2                                                     MAIN1     36
      I1=NODFL2-1                                                        MAIN1     37
      M=NODFL/2                                                          MAIN1     38
      FOIL=IFOIL                                                         MAIN1     39
      ALPHA=360./FOIL                                                    MAIN1     40
      IF(ALPHA.LT.2.*THETA)GO TO 10                                      MAIN1     41
      WRITE(6),9)                                                        MAIN1     42
    9 FORMAT(1H0,5(1H*),*  ERROR, FOIL LENGTH CAUSES 3 FOIL OVERLAP*)    MAIN1     43
      CALL EXIT                                                          MAIN1     44
   10 CONTINUE                                                           MAIN1     45
      PHI=THETA-ALPHA                                                    MAIN1     46
      ANGLE=PHI/(M-1)                                                    MAIN1     47
      WRITE(IOUT,600)                                                    MAIN1     48
      IBASE=1                                                            MAIN1     49
      NFOIL=1                                                            MAIN1     50
      NVECT=1                                                            MAIN1     51
      NS=12.                                                             MAIN1     52
      NODES=IFOIL*NODFL                                                  MAIN1     53
      NW=NODES-1                                                         MAIN1     54
      NEQ=NODES*NDOF                                                     MAIN1     55
      NN=(NEQ+NS-1)/NS                                                   MAIN1     56
      NBAND=(NW+1)*NDOF                                                  MAIN1     57
      MM=(NBAND+NDOF-1)/NS+2                                             MAIN1     58
      NF=NODFL*3*IFOIL                                                   MAIN1     59
      NELEM=(NODFL-1)*IFOIL                                              MAIN1     60
      JNODE=NODFL-1                                                      MAIN1     61
      FS=YM*AL*T**3/12.                                                  MAIN1     62
      T=T+TC                                                             MAIN1     63
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      IF(YM.LT.1.0E06) FS=FS*1.0E06                                          MAIN1   64
      IF(YM.LT.1.0E06)YM=YM*1.0E06                                           UH4/26   1
      WRITE(61,7)YM,FS                                                       UH4/22   1
    7 FORMAT(1H0,*MODULUS OF ELASTICITY = *,E15.5*/*1X,*EI FOR FOIL= *,      UH4/22   2
     *E15.5)                                                                 UH4/22   3
        FOIL=IFOIL                                                           MAIN1   67
      JNOD=NODFL                                                             MAIN1   68
      N=0                                                                    MAIN1   69
      FALPHA(IFOIL+1)=360                                                    MAIN1   70
      DO 14 I=1,IFOIL                                                        MAIN1   71
      FALPHA(I)=(I-1)*ALPHA                                                  MAIN1   72
   14 CONTINUE                                                               MAIN1   73
      DO 15 I=1,IFOIL                                                        MAIN1   74
      N1=N+1                                                                 MAIN1   75
      DO 17 J=N1,JNOD                                                        MAIN1   76
      FNOA(J)=(J-(I-1)*NODFL-1)*ANGLE+FALPHA(I)                              MAIN1   77
      IF(J.GE.NODFL*(I-1)+M+1)FNOA(J)=(J-NODFL*(I-1)-M-1)*ANGLE+FALPHA(I     MAIN1   78
     ++1)                                                                    MAIN1   79
      IF(J.EQ.JNOD)N=J                                                       MAIN1   80
   17 CONTINUE                                                               MAIN1   81
      JNOD=NODFL*(I+1)                                                       MAIN1   82
   18 IONE=1+(I-1)*NODFL                                                     MAIN1   83
      INN=I*NODFL                                                            MAIN1   84
      FI=I                                                                   MAIN1   85
      DO 40 J=IONE,INN                                                       MAIN1   86
      FNOA(J)=FNOA(J)*3.14159/180.0                                          MAIN1   87
   40 CONTINUE                                                               MAIN1   88
   15 CONTINUE                                                               MAIN1   89
      DO 1000 I=1,IFOIL                                                      MAIN1   90
      DO 1000 JP=1,JNODE                                                     MAIN1   91
      J=JP+(I-1)*NODFL                                                       MAIN1   92
      BETA=FNOA(J+1)-FNOA(J)                                                 MAIN1   93
      SB=SIN(BETA)                                                           MAIN1   94
      CB=COS(BETA)                                                           MAIN1   95
      SB2=2.*SB*CB                                                           MAIN1   96
      AT=BETA-SB                                                             MAIN1   97
      BT=CB+SB*SB/2.-1.                                                      MAIN1   98
      CT=1.5*BETA-2.*SB+SB2/4.                                               MAIN1   99
      DT=BETA/2.-SB2/4.                                                      MAIN1  100
      ET=CB-1.                                                               MAIN1  101
      A=ET*ET/BETA-DT                                                        MAIN1  102
      B=BT-AT*ET/BETA                                                        MAIN1  103
      C=AT*DT-BT*ET                                                          MAIN1  104
      D=AT*AT/BETA-CT                                                        MAIN1  105
      E=CT*ET-AT*BT                                                          MAIN1  106
      F=BT*BT-CT*DT                                                          MAIN1  107
      G=BT*(BT-2.*AT*ET/BETA)+CT*(FT*ET/BETA-DT)+AT*AT*DT/BETA               MAIN1  108
      GR3=G*R**3                                                             MAIN1  109
      SM(1,1)=A/GR3*FS                                                       MAIN1  110
      SM(1,2)=B/GR3*FS                                                       MAIN1  111
      SM(1,3)=C*R/BETA/GR3*FS                                                MAIN1  112
      SM(2,1)=SM(1,2)                                                        MAIN1  113
      SM(2,2)=D/GR3*FS                                                       MAIN1  114
      SM(2,3)=E*R/BETA/GR3*FS                                                MAIN1  115
      SM(3,1)=SM(1,3)                                                        MAIN1  116
      SM(3,2)=SM(2,3)                                                        MAIN1  117
      SM(3,3)=F*R**4/BETA/GR3*FS                                             MAIN1  118
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                DO 110 II=1,3                                                   MAIN1  119
                DO 110 JJ=1,3                                                   MAIN1  120
            110 SMS(II,JJ)=SM(II,JJ)                                            MAIN1  121
                SM(1,2)=-SM(1,2)                                                MAIN1  122
                SM(2,1)=-SM(2,1)                                                MAIN1  123
                SM(2,3)=-SM(2,3)                                                MAIN1  124
                SM(3,2)=-SM(3,2)                                                MAIN1  125
                DO 120 II=1,3                                                   MAIN1  126
                DO 120 JJ=1,3                                                   MAIN1  127
            120 SMS(II+3,JJ+3)=SM(II,JJ)                                        MAIN1  128
                SM(1,1)=(-A*CB-B*SB)/GR3*FS                                     MAIN1  129
                SM(1,2)=(-B*CB-D*SB)/GR3*FS                                     MAIN1  130
                SM(1,3)=(-C*CB-E*SB)*R/BETA/GR3*FS                              MAIN1  131
                SM(2,1)=(A*SB-B*CB)/GR3*FS                                      MAIN1  132
                SM(2,2)=(B*SB-D*CB)/GR3*FS                                      MAIN1  133
                SM(2,3)=(C*SB-E*CB)*R/BETA/GR3*FS                               MAIN1  134
                SM(3,1)=(A*(CB-1.)+B*SB-C/BETA)*R/GR3*FS                        MAIN1  135
                SM(3,2)=(B*(CB-1.)+D*SB-E/BETA)*R/GR3*FS                        MAIN1  136
                SM(3,3)=(C*(CB-1.)+E*SB-F)*R*R/BETA/GR3*FS                      MAIN1  137
                  DO 130 II=1,3                                                 MAIN1  138
                DO 130 JJ=1,3                                                   MAIN1  139
            130 SMS(II+3,JJ)=SM(II,JJ)                                          MAIN1  140
                CALL GMTRA(TRAE,TRRE,3,3)                                       MAIN1  141
                DO 140 II=1,3                                                   MAIN1  142
                DO 140 JJ=1,3                                                   MAIN1  143
            140 SMS(II,JJ+3)=SMT(II,JJ)                                         MAIN1  144
                JR=JP+(I-1)*JNODE                                               MAIN1  145
                DO 300 JJ=1,2                                                   MAIN1  146
                IBASE=IBASE+(JJ-1)                                              MAIN1  147
                NB(JR,JJ)=IBASE                                                 MAIN1  148
            300 CONTINUE                                                        MAIN1  149
                IF(((NFOIL*NCOFL)-1).NE.J) GO TO 350                            MAIN1  150
                IBASE=IBASE+1                                                   MAIN1  151
                NFOIL=NFOIL+1                                                   MAIN1  152
            350 CONTINUE                                                        MAIN1  153
                CALL WRITMS(LUE,SMS,36,JR)                                      MAIN1  154
              1 FORMAT(8A10)                                                    MAIN1  155
              3 FORMAT(16I5)                                                    MAIN1  156
              4 FORMAT(1X,16I5)                                                 MAIN1  157
              5 FORMAT(4I5,4F10.4,3I5)                                          MAIN1  158
              6 FORMAT(1X,8E12.4)                                               MAIN1  159
              8 FORMAT(F10.0)                                                   OH4/23   9
             80 FORMAT(1H1)                                                     MAIN1  160
             81 FORMAT(20X,8A10,/)                                              MAIN1  161
            410 FORMAT(2I5,3F10.4)                                              MAIN1  162
            600 FORMAT(1X,9E12.3,/)                                             MAIN1  163
            610 FORMAT(1X,18E7.1)                                               MAIN1  164
           1000 CONTINUE                                                        MAIN1  165
              C                                                                 MAIN1  166
                END                                                             MAIN1  167
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SUBROUTINE GMTRA      73/74   OPT=1 TRACE          GUF 4.5+414      10/25/76  08.56.27      PAGE     1

1                SUBROUTINE GMTRA (A,R,N,M)                                    GMTRA      2
                 DIMENSION A(1),R(1)                                           GMTRA      3
                 IR=0                                                          GMTRA      4
                 DO 10 I=1,N                                                   GMTRA      5
5                IJ=I-N                                                        GMTRA      6
                 DO 10 J=1,M                                                   GMTRA      7
                 IJ=IJ+N                                                       GMTRA      8
                 IR=IR+1                                                       GMTRA      9
              10 R(IR)=A(IJ)                                                   GMTRA     10
10               RETURN                                                        GMTRA     11
                 END                                                           GMTRA     12
```



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```
      OVERLAY(ISOFR1,6,0)                                                PRELOD     2
      PROGRAM PRELOD                                                     PRELOD     3
      COMMON/FOILLY/IFOIL,NODFL                                          PRELOD     4
      COMMON/RT/RS1,RB,R0,T,REF,RL                                       PRELOD     5
      COMMON/LOD/F(480,1),JDISP(30),S(6,6),RK(30,30),UR(160),U(480),NUT( PRELOD     6
     +30)                                                                PRELOD     7
     +,NFT(30),UB(11,1),AAK(30,30),ABK(30,11),BAK(11,30),BBK(11,11)      PRELOD     8
     +,C(11,30),F1(11,11),UF(30,11),UA(30,1),F2(11,1)                    PRELOD     9
      COMMON/CURRMZ/TITLE(8),ICM(30),FNOA(10)                            PRELOD    10
      COMMON/NSX/NS                                                      PRELOD    11
      COMMON/PDEL/R(160),RF(162),URASS(10),RASS(10)                      DH3/19     2
      COMMON/PDDISP/NDDISP,I1DDSP(160),I2DDSP(160),DDISPY(160),DDISPX(16 PRELOD    13
     +0)                                                                 PRELOD    14
      COMMON/BCP/NODES,NELEM,KODEBC(160),FDZ(160),FDR(160),NW            PRELOD    15
      COMMON/PSOL/NN,MM,NNPE,NDOF,NVECT,LUK,LUR,INDEX17(821),            PRELOD    16
     +INDEX19(41),KRECRD(820),NEQ                                        PRELOD    17
      COMMON/SYMSOL/DUD(2),NNPE1,NDOF1,DUM(3),LUE,LUX,INDEX3(41),INDEX7( PRELOD    18
     +146)                                                               PRELOD    19
      COMMON/SET/NODSET(160),NNODST                                      PRELOD    20
      COMMON/PLOTQ/IPLOT,NPLOT,IPRINT,MPRINT                             DH4/23    10
      COMMON/EC/EC                                                       DH4/24     1
      COMMON/SHAFT/RP                                                    PRELOD    22
      COMMON/ECC/THETA(160)                                              DH3/16     1
      DIMENSION RSP(160),RP(1)                                           DH3/16     2
      DIMENSION B(3,160)                                                 PRELOD    23
      DIMENSION PRE(160)                                                 PRELOD    24
      DIMENSION FR(11,1)                                                 PRELOD    25
      EQUIVALENCE (B(1,1),F(1,1))                                        PRELOD    26
      DATA LUK,LUR/17,19/                                                PRELOD    27
      CALL PLOTS(0,0,1)                                                  PRELOD    28
      CALL MEMSET(NODSET(1),NODSET(160),0)                               PRELOD    29
      CALL MEMSET(PRE(1),PRE(160),0.)                                    PRELOD    30
      CALL MEMSET(F(1,1),F2(11,1),0.)                                    PRELOD    31
      CALL MEMSET(FDZ(1),FDR(160),0.)                                    PRELOD    32
      CALL MEMSET(KODEBC(1),KODEBC(160),0)                               PRELOD    33
      CALL MEMSET(NDDISP,I2DDSP(160),0)                                  PRELOD    34
      CALL MEMSET(DDISPY(1),DDISPX(160),0.)                              PRELOD    35
      CALL MEMSET(KRECRD(1),KRECRD(820),0)                               PRELOD    36
      CALL OPENMS(LUK,INDEX17,821,0)                                     PRELOD    37
      CALL OPENMS(LUR,INDEX19,41,0)                                      PRELOD    38
      NNPE=NNPE1                                                         PRELOD    39
      NDOF=NDOF1                                                         PRELOD    40
      IK=NDOF*NODFL-NSD                                                  PRELOD    41
      NODFL2=NODFL/2                                                     PRELOD    42
      NDFF=NDOF*NODFL                                                    PRELOD    43
      IBASE=1                                                            PRELOD    44
      NFOIL=1                                                            PRELOD    45
      NVECT=1                                                            PRELOD    46
      NS=12                                                              PRELOD    47
      NODES=IFOIL*NODFL                                                  PRELOD    48
      NW=NODES-1                                                         PRELOD    49
      NEQ=NODES*NDOF                                                     PRELOD    50
      NN=(NEQ+NS-1)/NS                                                   PRELOD    51
      NBAND=(NW+1)*NDOF                                                  PRELOD    52
      MM=(NBAND-NDOF-1)/NS+2                                             PRELOD    53
      NELEM=(NODFL-1)*IFOIL                                              PRELOD    54
C     JDISP(1)=1                                                         PRELOD    55
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      C     DO 50 I=2,NDFF,3                                                  PRELOD  56
      C 50    JDISP(I)=1                                                      PRELOD  57
      C ASSEMBLE K MATRIX FOR FOIL                                            PRELOD  58
            NELEMF=NODFL-1                                                    PRELOD  59
            DO 100 K=1,NELEMF                                                 PRELOD  60
            CALL READMS(LUE,S,36,K)                                           PRELOD  61
            NED=1H                                                            PRELOD  62
            IF(IPRINT.NE.2)GO TO 95                                           DH4/14  5
            WRITE(61,103)NED                                                  DH4/14  6
            DO 98 NJ=1,6                                                      DH4/14  7
            WRITE(61,99)(S(NJ,JN),JN=1,6)                                     DH4/14  8
         98 CONTINUE                                                          PRELOD  66
         99 FORMAT(1H0,6(1X,E11.5))                                           PRELOD  67
         95 CONTINUE                                                          DH4/14  9
            I=(K-1)*NDOF+1                                                    PRELOD  68
            J1=(K-1)*NDOF+1                                                   PRELOD  69
            J2=(K-1)*NDOF+NNPE*NDOF                                           PRELOD  70
            DO 100 I=J1,J2                                                    PRELOD  71
            DO 100 J=J1,J2                                                    PRELOD  72
            M=J-(K-1)*NDOF                                                    PRELOD  73
            L=I-(K-1)*NDOF                                                    PRELOD  74
        100 RK(I,J)=RK(I,J)+S(L,M)                                            PRELOD  75
      C     WRITE(61,103)                                                     PRELOD  76
      C 103 FORMAT(1H0,A6,//)                                                 PRELOD  77
      C     DO 102 JJ=1,NDFF                                                  PRELOD  78
      C   WRITE(61,101)(RK(JJ,II),II=1,NDFF)                                  PRELOD  79
      C 102 CONTINUE                                                          PRELOD  80
      C 101 FORMAT(1H ,11(1X,E11.5))                                          PRELOD  81
      C CALCULATE SPECIFIED DISPLACEMENTS                                     PRELOD  82
      C       CHECKFOR 0 LOAD POSITION ON FIRST PASS                          PRELOD  83
            RNOT=RFF                                                          DH4/20  1
          106 CONTINUE                                                        DH4/20  2
            IPASS=1                                                           PRELOD  84
            CALL FGEO(SA,R2,RNOT,IPASS)                                       PRELOD  85
            IF(IPASS.EQ.3)GO TO 105                                           PRELOD  86
            IF(IPASS.EQ.3)GO TO 105                                           PRELOD  89
            CALL EXIT                                                         PRELOD  90
        105 CONTINUE                                                          PRELOD  91
            IF(IPRINT.NE.0)WRITE(61,104)SA,R2                                 DH4/24  2
        104 FORMAT(1H0,*SA=*,E11.5,2X,*R2=*,E11.5)                            PRELOD  93
            RFOIL=IFOIL                                                       PRELOD  94
      C RADIUS CALCULATIONS                                                   PRELOD  96
            IF(IPRINT.NE.0)WRITE(61,112)                                      DH4/23  12
            DO 110 I=1,NODFL                                                  PRELOD  98
            SL=FNOA(I)*RS1                                                    PRELOD  99
            ALPHA=SL/RFF                                                      PRELOD  100
            R(I)=SQRT(RFF**2+(RFF-(RB-T))**2-2.*RFF*(RFF-(RB-T))*COS(ALPHA))  PRELOD  101
            RASS(I)=R(I)                                                      PRELOD  102
            IF(IPRINT.EQ.0)GO TO 110                                          DH4/23  13
            WRITE(61,111)I,R(I),SL,ALPHA                                      DH4/23  14
        110 CONTINUE                                                          DH4/23  15
        111 FORMAT(1H ,*R(*,I2*)= *,E11.5,2F15.5)                             PRELOD  104
        112 FORMAT(1H0,*INITIAL RADIUS*,6X,*ARCLENGTH*,6X,*ANGLE*)            PRELOD  105
      C     CALCULATE DISP. FOR ASSEM.POSITION                              PRELOD  106
            UR(1)=0.                                                          PRELOD  107
            UR(NODFL-2)=R(NODFL-2)-(R2+T)                                     PRELOD  108
            UR(NODFL)=R(NODFL)-R2                                             PRELOD  109
```

```
      JDISP(1)=1                                                        PRELOD  110
      JDISP(2)=1                                                        PRELOD  111
      JDISP(NODFL2*NDOF-1)=1                                            PRELOD  112
      JDISP(NODFL*NDOF-1)=1                                             PRELOD  113
      NSD=4                                                             PRELOD  114
      J=1                                                               PRELOD  115
      DO 250 I=2,NDFF,3                                                 PRELOD  116
      U(I)=UR(J)                                                        PRELOD  117
250   J=J+1                                                             PRELOD  118
      L=1                                                               PRELOD  119
      J=1                                                               PRELOD  120
      K=NDOF*NODFL-NSD+1                                                PRELOD  121
      DO 260 I=1,NDFF                                                   PRELOD  122
      IF(JDISP(I).EQ.1)GO TO 255                                        PRELOD  123
      NUT(J)=I                                                          PRELOD  124
      NFT(J)=I                                                          PRELOD  125
      J=J+1                                                             PRELOD  126
      GO TO 260                                                         PRELOD  127
255   NFT(K)=I                                                          PRELOD  128
      NUT(K)=I                                                          PRELOD  129
      UB(L)=U(I)                                                        PRELOD  130
      K=K+1                                                             PRELOD  131
      L=L+1                                                             PRELOD  132
260   CONTINUE                                                          PRELOD  133
      IF(IPRINT.EQ.0)GO TO 264                                          DH4/22    4
      DO 262 I=1,30                                                     PRELOD  134
262   WRITE(61,261)I,NFT(I),I,NUT(I)                                    PRELOD  135
261   FORMAT(1H ,*NFT(*,I3,*)=*,I3,5X,*NUT(*,I3,*)=*,I3)                PRELOD  136
      WRITE(61,263)(UB(I),I=1,11)                                       PRELOD  137
 264  CONTINUE                                                          DH4/22    5
263   FORMAT(1H0,11(1X,F8.4))                                           PRELOD  138
      IK=NDOF*NODFL-NSD                                                 PRELOD  139
      IK1=IK+1                                                          PRELOD  140
C TRANSFORM K TO K PRIME                                                PRELOD  141
C ASSEMBLE K ALPHA ALPHA                                                PRELOD  142
      DO 300 I=1,IK                                                     PRELOD  143
      DO 300 J=1,IK                                                     PRELOD  144
      RKAAK=RK(NFT(I),NUT(J))                                           PRELOD  145
      ARK=ABS(RKAAK)                                                    PRELOD  146
      IF(ARK.GT.0..AND.ARK.LT.1.)RKAAK=0.                               PRELOD  147
300   AAK(I,J)=RKAAK                                                    PRELOD  148
C ASSEMBLE K A,B                                                        PRELOD  149
      NSD1=NSD+1                                                        PRELOD  150
      K=1                                                               PRELOD  151
      DO 310 I=1,IK                                                     PRELOD  152
      K=1                                                               PRELOD  153
      DO 310 J=IK1,NDFF                                                 PRELOD  154
      ABK(I,K)=RK(NFT(I),NUT(J))                                        PRELOD  155
310   K=J-IK+1                                                          PRELOD  156
C ASSEMBLE K B,A                                                        PRELOD  157
      K=1                                                               PRELOD  158
      DO 320 I=IK1,NDFF                                                 PRELOD  159
      DO 319 J=1,IK                                                     PRELOD  160
319   BAK(K,J)=RK(NFT(I),NUT(J))                                        PRELOD  161
320   K=K+1                                                             PRELOD  162
321   FORMAT(1H0,11(1X,E10.4))                                          PRELOD  163
C ASSEMBLE KBB                                                          PRELOD  164
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```
                      K=1                                                    PRELOD   165
                      L=1                                                    PRELOD   166
                      DO 335 I=IK1,NDFF                                      PRELOD   167
175                   L=1                                                    PRELOD   168
                      DO 330 J=IK1,NDFF                                      PRELOD   169
                      BBK(K,L)=RK(NFT(I),NUT(J))                             PRELOD   170
                330   L=J-IK+1                                               PRELOD   171
                335   K=K+1                                                  PRELOD   172
180             336   FORMAT(1H0,10(1X,E10.4))                               PRELOD   173
                C     WRITE(61,999)IPOSN,IK                                  PRELOD   174
                      D1=1.                                                  PRELOD   175
                      D2=1.                                                  PRELOD   176
                      HED=3HAAK                                              PRELOD   177
185             C     WRITE(61,103)HED                                       PRELOD   178
                C     DO 340KI=1,IK                                          PRELOD   179
                C340   WRITE(61,101)(AAK(KI,JI),JI=1,IK)                     PRELOD   180
                      IDGT=5                                                 PRELOD   181
                C     WRITE(61,339)IDGT                                      PRELOD   182
190             339   FORMAT(1H0,*IDGT=*,I3)                                 PRELOD   183
                      CALL INVERT(AAK,IK,30,NERR)                            PRELOD   184
                      HED=6HAAKINV                                           PRELOD   185
                C     WRITE(61,103)HED                                       PRELOD   186
                C     DO 341 KI=1,IK                                         PRELOD   187
195             C341   WRITE(61,101)(AAK(KI,JI),JI=1,IK)                     PRELOD   188
                      HED=3HABK                                              PRELOD   189
                C     WRITE(61,103)HED                                       PRELOD   190
                C     DO 342 KI=1,IK                                         PRELOD   191
                C342   WRITE(61,101)(ABK(KI,IJ),IJ=1,NSD)                    PRELOD   192
200                   HED=3HBAK                                              PRELOD   193
                C     WRITE(61,103)HED                                       PRELOD   194
                C     DO 343 KI=1,NSD                                        PRELOD   195
                C343   WRITE(61,101)(BAK(KI,IJ),IJ=1,IK)                     PRELOD   196
                      HED=3HBBK                                              PRELOD   197
205             C     WRITE(61,103)HED                                       PRELOD   198
                C     DO 344 KI=1,NSD                                        PRELOD   199
                C344   WRITE(61,101)(BBK(KI,IJ),IJ=1,NSD)                    PRELOD   200
                      CALL VMULFF(BAK,AAK,NSD,IK,IK,11,30,C,11,IER)          PRELOD   201
                      HED=1HC                                                PRELOD   202
210             C     WRITE(61,103)HED                                       PRELOD   203
                C     DO 345 KI=1,NSD                                        PRELOD   204
                C345   WRITE(61,101)(C(KI,IJ),IJ=1,IK)                       PRELOD   205
                      CALL VMULFF(C,F,NSD,IK,1,11,480,FB,11,IER)             PRELOD   206
                      HED=2HFB                                               PRELOD   207
215             C     WRITE(61,103)HED                                       PRELOD   208
                C     WRITE(61,101)FB                                        PRELOD   209
                      CALL VMULFF(C,ABK,NSD,IK,NSD),11,30,F1,11,IER)         PRELOD   210
                      HED=2HF1                                               PRELOD   211
                C     WRITE(61,103)HED                                       PRELOD   212
220             C     DO 346 KI=1,NSD                                        PRELOD   213
                C346   WRITE(61,101)(F1(KI,IJ),IJ=1,NSD)                     PRELOD   214
                      DO 350 I=1,NSD                                         PRELOD   215
                      DO 350 J=1,NSD                                         PRELOD   216
                350   F1(I,J)=F1(I,J)-BBK(I,J)                               PRELOD   217
225                   CALL VMULFF(F1,UB,NSD,NSD,1,11,11,F2,11,IER)           PRELOD   218
                      HED=2HF2                                               PRELOD   219
                C     WRITE(61,103)HED                                       PRELOD   220
                C     WRITE(61,101)F2                                        PRELOD   221
```



0 0 0 2 2 5

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      DO 360 I=1,NSD                                                    PRELOD   222
230   360 FB(I,1)=FB(I,1)-F2(I,1)                                       PRELOD   223
      C FB IS RESULTANT PRELOAD                                         PRELOD   224
      IF(IPRINT.EQ.0)GO TO 361                                          UH4/22     6
      WRITE(6,400)                                                      PRELOD   225
      400 FORMAT(1H0,*ASSEMBLY LOAD FOR ONE FOIL*)                      PRELOD   226
235   DO 500 I=1,NSD                                                    PRELOD   227
      IJ=I+IK                                                           PRELOD   228
      II=NFT(IJ)                                                        PRELOD   229
      500 WRITE(6,510)II,FB(I,1)                                        PRELOD   230
      510 FORMAT(1H ,*DOF(*,I2,*)=*,F10.3)                              PRELOD   231
240   361 CONTINUE                                                      UH4/22     7
      DO 700 I=2,NSD                                                    PRELOD   232
      II=I-1                                                            PRELOD   233
      700 PRE(II)=FB(I,1)                                               PRELOD   234
      C CALCULATE UNKNOWN DISP.                                         PRELOD   235
245   CALL VMULFF(AAK,ABK,IK,IK,NSD,30,30,UT,30,IER)                    PRELOD   236
      CALL VMULFF(UT,UB,IK,NSD,1,30,11,UA,30,IER)                       PRELOD   237
      DO 800 I=1,IK                                                     PRELOD   238
      800 UA(I)=-UA(I)                                                  PRELOD   239
      IF(IPRINT.EQ.0)GO TO 819                                          UH4/22     8
250   WRITE(6,810)                                                      PRELOD   240
      810 FORMAT(1H0,*UNSPECIFIED DISPACEMENTS CALCULATED*)             PRELOD   241
      DO 820 I=1,IK                                                     PRELOD   242
      J=NUT(I)                                                          PRELOD   243
      820 WRITE(6,821)J,UA(I)                                           PRELOD   244
255   821 FORMAT(1H ,*U(*,I2,*)=*,F10.6)                                PRELOD   245
      819 CONTINUE                                                      UH4/22     9
      DO 826 JK=1,IFOIL                                                 PRELOD   246
      IF(IPRINT.EQ.0)GO TO 829                                          UH4/23    16
      WRITE(6,850)JK                                                    UH4/22    10
260   850 FORMAT(//,1X,*FOIL *,I3,/,1H ,*NODE*,12X,*INITIAL*,19X,*U*,14X,  UH4/22    11
     +*FINAL*,/,                                                        UH4/22    12
     +1X,80(1H*),/)                                                     PRELOD   249
      829 CONTINUE                                                      UH4/23    17
      DO 822 I=1,NODFL                                                  PRELOD   250
265   IDOF=I*NDOF-1                                                     PRELOD   251
      IF(JDISP(IDOF).EQ.1)GO TO 823                                     PRELOD   252
      DO 824 K=1,NDFF                                                   PRELOD   253
      J=NFT(K)                                                          PRELOD   254
      IF(J.EQ.IDOF)GO TO 825                                            PRELOD   255
270   824 CONTINUE                                                      PRELOD   256
      825 IDOF=K                                                        PRELOD   257
      RF((JK-1)*NODFL+I)=R(I)-UA(IDOF)                                  PRELOD   258
      URASS(I)=UA(IDOF)                                                 PRELOD   259
      IF(IPRINT.EQ.0)GO TO 822                                          UH4/24     3
275   WRITE(6,851)I,R(I),UA(IDOF),RF((JK-1)*NODFL+I)                    PRELOD   260
      GO TO 822                                                         PRELOD   261
      823 CONTINUE                                                      PRELOD   262
      RF((JK-1)*NODFL+I)=R(I)-UR(I)                                     PRELOD   263
      URASS(I)=UR(I)                                                    PRELOD   264
280   IF(IPRINT.EQ.0)GO TO 822                                          UH4/23    18
      WRITE(6,851)I,R(I),UR(I),RF((JK-1)*NODFL+I)                       PRELOD   265
      822 CONTINUE                                                      PRELOD   266
      826 CONTINUE                                                      PRELOD   267
      C     CHECK TO SEE IF ASSEMBLY POSITION IS VALID                  UH4/20     3
285   NODFL2I=NODFL2-1                                                  UH4/20     4
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                DO 827 I=1,NODFL21                                              DH4/20     5
                IF(RF(I+NODFL2).LE.RF(1)-T)GO TO 827                            DH4/20     6
          C     NOT A VALID POSITION                                            DH4/20     7
                RNOT=0.995*RNOT                                                 DH4/20     8
      290       IF(IPRINT.EQ.0)GO TO 106                                        DH4/23    19
                WRITE(61,828)                                                   DH4/22    13
            828 FORMAT(1H0,1H*,*THIS IS NOT A VALID ASSEMBLY POSITION. GEOMETRY * DH4/22    14
               +*ROUTINE WILL CONTINUE TO SEARCH.*)                             DH4/22    15
                GO TO 106                                                       DH4/20     9
      295       827 CONTINUE                                                    DH4/20    10
                IF(IPRINT.NE.0)GO TO 840                                        DH4/23    20
                WRITE(61,835)                                                   DH4/23    21
                DO 831 I=1,NODFL                                                DH4/23    22
                WRITE(61,851)I,RF(I)                                            DH4/23    23
      300       831 CONTINUE                                                    DH4/23    24
                835 FORMAT(1H0,*NODE*,5X,*ASSEMBLY RADIUS FROM CENTER OF BEARING*,/, DH4/26  2
               +1X,80(1H*))                                                     DH4/26    3
                840 CONTINUE                                                    DH4/23    26
                DO 830 I=1,NODFL                                                PRELOD   268
      305       DO 830 N=1,NDOF                                                 PRELOD   269
                IDOF=I*NDOF-(NDOF-N)                                            PRELOD   270
                IF(JDISP(IDOF).EQ.1)GO TO 830                                   PRELOD   271
                DO 832 K=1,NDFF                                                 PRELOD   272
                J=NFT(K)                                                        PRELOD   273
      310       IF(J.EQ.IDOF)GO TO 833                                          PRELOD   274
          832   CONTINUE                                                        PRELOD   275
          833   CONTINUE                                                        PRELOD   276
                U(IDOF)=UA(K)                                                   PRELOD   277
          830   CONTINUE                                                        PRELOD   278
      315       IF(IPLOT.GE.1)NPLOT=1                                           DH3/19     4
                IF(IPLOT.GE.1)CALL OVERLAY(6HISOFB1,6,4)                        PRELOD   279
                NPLOT=0                                                         DH3/19     5
          851   FORMAT(1H ,I4,3F20.4)                                           PRELOD   280
                WRITE(61,852)                                                   PRELOD   281
      320       852 FORMAT(1H0,80(1H*))                                         PRELOD   282
                DO 853 I=1,NODES                                                PRELOD   283
          853   R(I)=RF(I)                                                      PRELOD   284
          C     FIX NODE 1                                                      PRELOD   285
                NDDISP=0                                                        PRELOD   286
      325       NDDISP=1                                                        PRELOD   287
                I1DDSP(1)=NODFL/2                                               PRELOD   288
                I2DDSP(1)=-NODES                                                PRELOD   289
                DO 864 I=1,IFOIL                                                PRELOD   290
                NUM=(I-1)*NODFL+1                                               PRELOD   291
      330       CALL PACK60(KODEBC(NUM),1,1)                                    PRELOD   292
                CALL PACK60(KODEBC(NUM),1,2)                                    PRELOD   293
                FDZ(NUM)=0.                                                     PRELOD   294
          C      SET OVERLAPING NODES                                           PRELOD   295
                IF(I.EQ.IFOIL)GO TO 864                                         PRELOD   296
      335       NDDISP=NDDISP+1                                                 PRELOD   297
                N1=I*NODFL                                                      PRELOD   298
                N2=I*NODFL+NODFL/2                                              PRELOD   299
                I1DDSP(NDDISP)=N1                                               PRELOD   300
                I2DDSP(NDDISP)=-N2                                              PRELOD   301
      340       864 CONTINUE                                                    PRELOD   302
                READ(60,860)RFINAL,DELR,RINIT                                   PRELOD   304
                IF(DELR.EQ.0.)RINIT=RFINAL                                      DH4/23    27
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      WRITE(61,866)RFINAL                                                DH4/23   28
  866 FORMAT(1H0,*SHAFT RADIUS = *,F10.4)                                DH4/23   29
      KEC=0                                                              DH3/16    3
      IEC=0                                                              DH3/16    4
      READ(60,860)EFINAL,DELF,EINIT                                      DH3/16    5
      READ(60,860)PSI                                                    DH3/16    6
      WRITE(61,865)EFINAL,DELF,EINIT,PSI                                 DH3/16    7
  865 FORMAT(1H0,*FFINAL,DELF,EINIT,PSI   =*,4E15.5)                     DH3/16    8
      RS=RFINAL                                                          DH3/16    9
      EC=0.                                                              DH3/29    1
      IF(RFINAL.LE.RB-2.*T)GO TO 861                                     PRELOD  305
      WRITE(61,862)                                                      PRELOD  306
  862 FORMAT(1H0,*WARNING....RFINAL TO LARGE. RFINAL RESET.*)            PRELOD  307
      RFINAL=RB-2.*T                                                     PRELOD  308
  861 CONTINUE                                                           PRELOD  309
      IF(DELR.EQ.0.)GO TO 867                                            DH4/23   30
      WRITE(61,863)RFINAL,DELR,RINIT                                     PRELOD  310
  863 FORMAT(1H0,*RFINAL,DELR,RINIT -*,3F15.5)                           PRELOD  311
  859 FORMAT(1H0,*RFINAL    ,DELR*)                                      PRELOD  312
  860 FORMAT(3F10.0)                                                     PRELOD  313
  867 CONTINUE                                                           DH4/23   31
C      FIND NODE WITH MINIMUM RADIUS                                     PRELOD  314
      CALL SHAFTBC(RP,RINIT,RFINAL,DELR,RMINF,KEC,ICHNG)                 DH3/24    1
      CALL MEMSET(RSP(1),RSP(160),RP)                                    DH3/16   12
      IF(RMINF.GE.RFINAL)GO TO 1000                                      PRELOD  316
  868 FORMAT(1H ,*NODE *,I3,* SET*)                                      PRELOD  317
  869 CONTINUE                                                           PRELOD  318
      DO 901 K=1,IFOIL                                                   PRELOD  319
      I1=(K-1)*NODFL+2                                                   PRELOD  320
      I2=K*NODFL                                                         PRELOD  321
      DO 900 I=I1,I2                                                     PRELOD  322
      CALL UNPCK60(KODEBC(I),L,2)                                        PRELOD  323
      IF(L.EQ.0)GO TO 900                                                PRELOD  324
      IF(NODSET(I).EQ.0)GO TO 900                                        PRELOD  325
      FDR(I)=R(I)-RSP(I)                                                 DH3/16   13
      DO 898 N=1,NDDISP                                                  PRELOD  327
      IF(I.EQ.IABS(I2DDSP(N)).AND.I.LT.NODES-NODFL/2+1)FDR(I)=R(I)-RSP   DH3/16   14
     +(I)-T                                                              DH3/16   15
  898 CONTINUE                                                           PRELOD  329
  900 CONTINUE                                                           PRELOD  330
  901 CONTINUE                                                           PRELOD  331
 1000 CONTINUE                                                           PRELOD  332
C      ASSEMBLE K MATRIX                                                 PRELOD  333
      IF(MM.GT.NN)MM=NN                                                  PRELOD  334
  871 FORMAT(1H ,*NODSET(8)=*,I3)                                        PRELOD  335
      CALL OVERLAY(6HISOFB1,6,1)                                         PRELOD  336
  870 CALL OVERLAY(6HISOFB1,6,2)                                         PRELOD  337
      CALL OVERLAY(6HISOFB1,6,3)                                         PRELOD  338
C      ADD IN ASSEMBLY LOAD FOR TOTAL LOADS                              PRELOD  339
      IF(IPRINT.EQ.0)GO TO 872                                           DH4/14   10
      WRITE(61,874)                                                      PRELOD  340
      DO 878 J=1,IFOIL                                                   PRELOD  341
      I1=(J-1)*NODFL+1                                                   PRELOD  342
      I2=J*NODFL                                                         PRELOD  343
      DO 875 I=I1,I2                                                     PRELOD  344
      IDOF=I*NDOF-1                                                      PRELOD  345
      DO 873 L=1,NSD                                                     PRELOD  346
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                      K=L+IK                                                    PRELOD   347
                C     IF(NFT(K).EQ.IDOF)F(IDOF+(J-1)*NDFF)=F(IDOF+(J-1)*NDFF)+FB(L,1)   PRELOD   348
                873   CONTINUE                                                  PRELOD   349
                      WRITE(61,876)I,(B(JB,I),JB=1,NDOF)                        PRELOD   350
                875   CONTINUE                                                  PRELOD   351
                878   CONTINUE                                                  PRELOD   352
                      WRITE(6,877)                                              PRELOD   353
                874   FORMAT(//,1H0,*TOTAL LOADS  (INCLUDES ASSEMBLY LOAD)*,//  PRELOD   354
                     +,1X,*NODE*,5X,*TANGENTIAL*,10X,*RADIAL*,14X,*ROTATIONAL*,/  PRELOD   355
                     +,1X,50(1H*))                                              PRELOD   356
                876   FORMAT(1H ,I2,3(E15.5))                                   PRELOD   357
                877   FORMAT(1H ,50(1H*))                                       PRELOD   358
                 872  CONTINUE                                                  DH4/14    11
                C      CHECK LOADS FOR CORRECT SIGN                             PRELOD   359
                      ISET=0                                                    PRELOD   360
                      DO 1015 K=1,IFOIL                                         PRELOD   361
                      I1=(K-1)*NODFL+2                                          PRELOD   362
                      I2=K*NODFL                                                PRELOD   363
                      DO 1010I=I1,I2                                            PRELOD   364
                      IDOF=I*NDOF-1                                             PRELOD   365
                      DO 1009 N=1,NDDISP                                        PRELOD   366
                      N1=I1DDSP(N)                                              PRELOD   367
                      N2=IABS(I2DDSP(N))                                        PRELOD   368
                      IF(I.EQ.N1.OR.I.EQ.N2)GO TO 1003                          PRELOD   369
                1009  CONTINUE                                                  PRELOD   370
                      CALL UNPCK60(KODEBC(I),L,2)                               PRELOD   371
                      IF(L.EQ.0)GO TO 1010                                      PRELOD   372
                      IF(IPRINT.NE.0)WRITE(61,999)I,UR(I),IDOF,F(IDOF)          DH4/14    12
                C      SEPERATE B.C. NODES                                      PRELOD   374
                      IF(NODSET(I).NE.0)GO TO 1008                              PRELOD   375
                1007  CONTINUE                                                  PRELOD   376
                      GO TO 1005                                                PRELOD   377
                1008  CONTINUE                                                  PRELOD   378
                999   FORMAT(1H ,*UR(*,I3,*)=*,E12.5,3X,*F(*,I3,*)=*,E12.5)     PRELOD   379
                      IF(UR(I).GE.0..AND.F(IDOF).GE.0.)GO TO 1010                PRELOD   380
                      IF(UR(I).LE.0..AND.F(IDOF).LE.0.)GO TO 1010                PRELOD   381
                      ISET=1                                                    PRELOD   382
                      CALL PACK60(KODEBC(I),0,2)                                PRELOD   383
                      FOR(I)=0.                                                 PRELOD   384
                      NNODST=NNODST-1                                           PRELOD   385
                      NODSET(I)=0                                               PRELOD   386
                      IF(IPRINT.NE.0)WRITE(61,1011)I                            DH4/24     4
                      GO TO 1010                                                PRELOD   388
                1005  CONTINUE                                                  PRELOD   389
                      IF(UR(I)*F(IDOF).LT.0.)GO TO 1010                         PRELOD   390
                      IF(IPRINT.NE.0)WRITE(61,1013)I                            DH4/24     5
                1013  FORMAT(1H ,*R.C. NODE*,I3,* RELEASED*)                    PRELOD   392
                      CALL PACK60(KODEBC(I),0,2)                                PRELOD   393
                      FOR(I)=0.                                                 PRELOD   394
                      ISET=1                                                    PRELOD   395
                1011  FORMAT(1H ,*RELEASE NODE *,I3)                           PRELOD   396
                      GO TO 1010                                                PRELOD   397
                1003  CONTINUE                                                  PRELOD   398
                C      CHECK B.C. FOR DISP PAIRS                                PRELOD   399
                      CALL UNPCK60(KODEBC(N2),L,2)                              PRELOD   400
                      IF(L.EQ.0)GO TO 1010                                      PRELOD   401
                      IF(NODSET(N2).EQ.0)GO TO 1004                             PRELOD   402
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                      IF(F(N2*NDOF-1)+F(N1*NDOF-1).LE.0.)GO TO 1010                    PRELOD   403
                      CALL PACK60(KODEBC(N2),0,2)                                      PRELOD   404
                      FOR(N2)=0.                                                       PRELOD   405
  460                 ISET=1                                                           PRELOD   406
                      NODSET(N2)=0                                                     PRELOD   407
                      IF(IPRINT.NE.0)WRITE(6,1011)N2                                   DH4/24     6
                      GO TO 1010                                                       PRELOD   409
                 1004 CONTINUE                                                         PRELOD   410
  465                 IF(F(N2*NDOF-1)+F(N1*NDOF-1).GE.0.)GO TO 1010                    PRELOD   411
                      CALL PACK60(KODEBC(N2),0,2)                                      PRELOD   412
                      FOR(N2)=0.                                                       PRELOD   413
                      ISET=1                                                           PRELOD   414
                      IF(IPRINT.NE.0)WRITE(6,1013)N2                                   DH4/24     7
  470            1010 CONTINUE                                                         PRELOD   416
                 1015 CONTINUE                                                         PRELOD   417
                      IF(ISET.EQ.1)GO TO 1000                                          PRELOD   418
                 1016 CONTINUE                                                         DH3/16    16
                 C     CHECK TO SEE IF ALL NODES ARE LIFTED                            PRELOD   419
                 C     CHECK TO SEE IF MORE NODES NEED TO BE SET                       PRELOD   433
  475            CALL SHAFT2(RSP,RINIT,RFINAL,DELR,RMINF,KEC,ICHNG)                   DH3/24     4
                      IF(ICHNG.EQ.0)GO TO 1050                                         DH3/24     5
                      GO TO 869                                                        PRELOD   435
                 1050 CONTINUE                                                         PRELOD   436
  480            C     CHECK TO SEE IF DISP PAIRS NEED TO BE RELEASED                  PRELOD   437
                      IREL=0                                                           PRELOD   438
                      DO 1100 I=1,NDDISP                                               PRELOD   439
                      I1=I1DDSP(I)                                                     PRELOD   440
                      IF(I1.EQ.0)GO TO 1100                                            PRELOD   441
  485                 I2=IABS(I2DDSP(I))                                               PRELOD   442
                 C     CHECK FOR R.C. NODE                                             PRELOD   443
                      CALL UNPCK60(KODEBC(I2),L,2)                                     PRELOD   444
                      IF(L.EQ.1)GO TO 1100                                             PRELOD   445
                 C     CHECK TO SEE IF FORCE OF DEP. NODE IS PROPER SIGN               PRELOD   446
  490                 IF(I2.GT.NODFL/2.AND.I2.LE.(IFOIL)*NODFL-NODFL/2)GO TO 1060      PRELOD   447
                      IF(F(I1*NDOF-1).LE.0.)GO TO 1100                                 PRELOD   448
                 1065 IREL=IREL+1                                                      PRELOD   449
                      I1DDSP(I)=0                                                      PRELOD   450
                      I2DDSP(I)=0                                                      PRELOD   451
  495                 DDISPY(I)=0.                                                     PRELOD   452
                      GO TO 1070                                                       PRELOD   453
                 1060 CONTINUE                                                         PRELOD   454
                      IF(F(I1*NDOF-1).GT.0.)GO TO 1100                                 PRELOD   455
                      GO TO 1065                                                       PRELOD   456
  500            1070 CALL PACK60(KODEBC(I1),0,2)                                      PRELOD   457
                      IF(IPRINT.EQ.0)GO TO 1100                                        DH4/24     8
                      WRITE(61,1101)I1,I2                                              PRELOD   458
                 1101 FORMAT(1H0,*NODES*,I3,* AND*,I3,*RELEASED AS DISP. PAIRS*)       PRELOD   459
                 1100 CONTINUE                                                         PRELOD   460
  505                 IF(IREL.NE.0)GO TO 1000                                          PRELOD   461
                 C     CHECK FOR NEW DISP PAIRS                                        PRELOD   462
                      ISPEC=0                                                          PRELOD   463
                      IDDSP=NDDISP                                                     PRELOD   464
                      NODFL2=NODFL/2                                                   PRELOD   465
  510                 NOD21=NODFL/2+2                                                  PRELOD   466
                      DO 1112 J=1,IFOIL                                                PRELOD   467
                      I1=(J-1)*NODFL+NOD21                                             PRELOD   468
                      I2=J*NODFL                                                       PRELOD   469
```



62500

```
                DO 1110 I=I1,I2                                                 PRELOD   470
                DO 1109 N=1,NDDISP                                              PRELOD   471
                IF(I.EQ.IABS(I2DDSP(N)))GO TO 1110                              PRELOD   472
                IF(I.EQ.I1DDSP(N))GO TO 1110                                    PRELOD   473
           1109 CONTINUE                                                        PRELOD   474
                N2=I                                                            PRELOD   475
                N1=I+NODFL2                                                     PRELOD   476
                IF(J.EQ.IFOIL)N2=NODFL2-(NODES-I)                               PRELOD   477
                IF(J.EQ.IFOIL)N1=I                                              PRELOD   478
           C     CHECK IF IND. NODE IS ON LAST HALF OF LAST FOIL                PRELOD   479
                IF(N1.GT.NODFL/2.AND.N1.LE.(IFOIL)*NODFL-NODFL/2)GO TO 1108     PRELOD   480
                IF(RF(N2)-RF(N1)-T)1105,1110,1110                               PRELOD   481
           1105 CONTINUE                                                        PRELOD   482
           C     CHECK TO SEE IF DEP. NODE IS H.C.                              PRELOD   483
                CALL UNPCK60(KODEBC(N2),L,2)                                    PRELOD   484
                IF(L.EQ.1.AND.NODSET(N2).EQ.0)GO TO 1106                        PRELOD   485
                NDDISP=NDDISP+1                                                 PRELOD   489
                I1DDSP(NDDISP)=N2                                               PRELOD   490
                I2DDSP(NDDISP)=-N1                                              PRELOD   491
                DDISPY(NDDISP)=R(N2)-T-R(N1)                                    PRELOD   492
           C     CHECK IF IND. NODE IS ON LAST HALF OF LAST FOIL                PRELOD   493
                IF(N1.GT.NODFL/2.AND.N1.LE.(IFOIL)*NODFL-NODFL/2)DDISPY(NDDISP)= PRELOD   494
               +R(N2)-R(N1)+T                                                   PRELOD   495
                IF(IPRINT.EQ.0)GO TO 1110                                       DH4/24     9
                WRITE(61,1111)NDDISP,N1,N2,DDISPY(NDDISP)                       PRELOD   496
                GO TO 1110                                                      PRELOD   497
           1108 CONTINUE                                                        PRELOD   498
                IF(RF(N1)-RF(N2)-T)1105,1110,1110                               PRELOD   499
           1106 CONTINUE                                                        PRELOD   500
           C     SET NODE N1 AS SPEC. DISP.                                     PRELOD   501
                IF(J.NE.IFOIL)GO TO 1104                                        DH3/29     2
                CALL PACK60(KODEBC(N1),1,2)                                     PRELOD   502
                ISPEC=1                                                         PRELOD   503
                FOR(N1)=R(N1)-(RB-2.*T)                                         PRELOD   504
                IF(IPRINT.EQ.0)GO TO 1110                                       DH4/24    10
                WRITE(61,1131)N1                                                PRELOD   505
                GO TO 1110                                                      DH3/29     3
            1104 CONTINUE                                                       DH3/29     4
           C     DEP NODE IS ON SHAFT                                           DH3/29     5
           1107 CONTINUE                                                        PRELOD   506
           1111 FORMAT(1H0,*NDDISP,N1,N2,DDISPY(NDDISP)=   *,3I5,E15.5)         PRELOD   512
           1110 CONTINUE                                                        PRELOD   513
           1112 CONTINUE                                                        PRELOD   514
                IF(IDDSP.NE.NDDISP)GO TO 1000                                   PRELOD   515
                IF(ISPEC.EQ.1)GO TO 1000                                        PRELOD   516
           1120 CONTINUE                                                        PRELOD   517
           C     CHECK FOR BOUNDRY CONDITION VIOLATIONS                         PRELOD   518
                IBC=0                                                           PRELOD   519
                DO 1151 J=1,IFOIL                                               PRELOD   520
                I1=(J-1)*NODFL+2                                                PRELOD   521
                I2=J*NODFL                                                      PRELOD   522
                DO 1150 I=I1,I2                                                 PRELOD   523
                DO 1130 N=1,NDDISP                                              PRELOD   524
                IF(I.EQ.I1DDSP(N))GO TO 1150                                    PRELOD   525
           1130 CONTINUE                                                        PRELOD   526
                E=T                                                             PRELOD   527
                IF(I.GE.(J-1)*NODFL+NODFL/2+1)E=2.*T                            PRELOD   528
```

```
                ROUND=(RF(1)+0.00005)*10000.                                    DH4/5     1
                IROUND=ROUND                                                    DH4/5     2
                RFROUND=FLOAT(IROUND)/10000.                                    DH4/5     3
                IF(RFROUND.LE.RB-E)GO TO 1150                                   DH4/5     4
      575       IF(RF(I).LE.RB-E)GO TO 1150                                     PRELOD  529
              C  NODE I VIOLATES B.C.                                           PRELOD  530
                CALL PACK60(KODEBC(I),1,2)                                      PRELOD  531
                IBC=1                                                           PRELOD  532
                FOR(I)=R(1)-(RB-E)                                              PRELOD  533
      580       IF(IPRINT.EQ.0)GO TO 1151                                       DH4/24   11
                WRITE(61,1131)I                                                 PRELOD  534
                GO TO 1151                                                      PRELOD  535
           1131 FORMAT(1H0,*NODE*,I3,* VIOLATES B.C.,CONSTRAIN*)                PRELOD  536
           1150 CONTINUE                                                        PRELOD  537
      585  1151 CONTINUE                                                        PRELOD  538
                IF(IBC.EQ.1)GO TO 1000                                          PRELOD  539
                IF(KEC.EQ.1)GO TO 1500                                          DH3/16   20
                IF(RSP.EQ.RFINAL)GO TO 1500                                     DH3/16   21
                RSP=RSP+DELR                                                    DH3/16   22
      590       DO 1200 I=1,NODES                                               DH3/30    1
                NODSET(I)=IABS(NODSET(I))                                       DH3/30    2
           1200 CONTINUE                                                        DH3/30    3
                IF(RSP.GT.RFINAL)RSP=RFINAL                                     DH3/16   23
                GO TO 869                                                       PRELOD  543
      595  1500 CONTINUE                                                        PRELOD  544
                IF(KEC.EQ.0)CALL EMOD(RSP,EC,RS,PSI)                           DH3/29    6
                IF(IPLOT.GE.2)CALL OVERLAY(6HISOFB1,6,4)                        PRELOD  545
                RFX=0.                                                          DH3/16   25
                RFY=0.                                                          DH3/16   26
      600       CALL MEMSET(PRE(1),PRE(160),0.)                                 PRELOD  547
              C  FIND NODES ON SHAFT                                            PRELOD  548
                NODFL21=NODFL/2+1                                               PRELOD  549
                IF(IPRINT.EQ.0)IPRINT=-1                                        DH4/23   32
                IF(MPRINT.EQ.0)CALL OVERLAY(6HISOFB1,6,3)                       DH4/23   33
      605       IF(IPRINT.EQ.-1)IPRINT=0                                        DH4/23   34
                WRITE(61,1690)EC                                                DH3/29    7
                WRITE(61,1610)                                                  DH3/19    6
                DO 1601 J=1,IFOIL                                               PRELOD  550
                I1=(J-1)*NODFL+NODFL21                                          PRELOD  551
      610       I2=J*NODFL                                                      PRELOD  552
                DO 1600 II=I1,I2                                                DH3/20    1
                I=II                                                            DH3/20    2
              C  CHECK FOR DISP. PAIRS                                          DH3/20    3
                DO 1580 N=1,NDDISP                                              DH3/20    4
      615       IF(I.EQ.I1DDSP(N))I=IABS(I2DDSP(N))                             DH3/20    5
                CALL UNPCK60(KODEBC(I),L,2)                                     DH3/20    6
                IF(L.EQ.0)GO TO 1600                                            DH3/20    7
                IF(I.EQ.IABS(I2DDSP(N)))GO TO 1590                              DH3/20    9
           1580 CONTINUE                                                        DH3/20   10
      620       IF(NODSET(I).EQ.0)GO TO 1600                                    DH3/22    1
              C  CALCULATE SHAFT LOAD ON NON DDISP                              PRELOD  561
                PRE(I)=R(2,I)                                                   PRELOD  562
                GO TO 1599                                                      DH3/19    8
           1590 CONTINUE                                                        PRELOD  564
      625       IF(NODSET(I).EQ.0)GO TO 1600                                    DH3/23   10
              C  CALCULATE SHAFT LOAD ON DDISP NODE                             PRELOD  565
                PRE(I)=R(2,I)+R(2,I1DDSP(N))                                    PRELOD  566
```



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                1599 CONTINUE                                                          DH3/16    27
                     PREX=-PRE(I)*SIN(THETA(I))                                        DH3/16    28
630                  PREY=-PRE(I)*COS(THETA(I))                                        DH3/16    29
                     RFX=RFX+PREX                                                      DH3/16    30
                     RFY=RFY+PREY                                                      DH3/16    31
                     WRITE(61,1612)I,PRE(I),PREX,PREY                                  DH3/16    32
               1612  FORMAT(1H ,I5,3X,3(F10.3,3X))                                     DH3/16    33
635            1600  CONTINUE                                                          PRELOD   567
               1601  CONTINUE                                                          PRELOD   568
               1610  FORMAT(1H0,*SHAFT LOADS*,/,1X,*NODE*,3X,*TOTAL LOAD*,8X,*FX*,13X, DH4/23    35
                    +*FY*)                                                             DH4/23    36
                     WRITE(61,1611)                                                    PRELOD   571
640            1611  FORMAT(1H ,30(1H*))                                               PRELOD   572
                     RFT=SQRT(RFX**2+RFY**2)                                           DH3/16    34
                     IF(RFT.EQ.0.)GO TO 1614                                           DH3/16    35
                     RFA=ATAN2(RFX,RFY)                                                DH3/16    36
                1614 CONTINUE                                                          DH3/16    37
645                  WRITE(61,1613)RFX,RFY,RFT,RFA                                     DH3/16    38
               1613  FORMAT(16X,*RESULTANT FORCE-X   RESULTANT FORCE-Y   TOTAL FORCE*  DH4/23    37
                    +*        ANGLE*,/,1X,4F20.4)                                      DH4/23    38
                     WRITE(61,1611)                                                    PRELOD   575
                     IF(IEC.EQ.1)GO TO 1700                                            DH3/16    41
650                  IF(EC.GE.EFINAL)IEC=1                                             DH3/16    42
                     EC=EC+DELE                                                        DH3/16    44
                     IF(KEC.EQ.0)EC=EINIT                                              DH3/29     8
                     KEC=1                                                             DH3/29     9
                     IF(EC.GT.EFINAL)EC=EFINAL                                         DH3/16    45
655                  CALL EMOD(RSP,EC,RS,PST)                                          DH3/29    10
                     DO 1620 I=1,NODES                                                 DH3/30     4
                     NODSET(I)=IABS(NODSET(I))                                         DH3/30     5
                1620 CONTINUE                                                          DH3/30     6
                     GO TO 1016                                                        DH3/16    47
660            1690  FORMAT(1H0,10(1H*),3X,*ECCENTRICITY= *,F10.6)                     DH3/16    48
               1700  CONTINUE                                                          DH3/16    49
                     CALL PLOT(0.,0.,999)                                              DH4/22    16
                     END                                                               PRELOD   576
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CARD NR. SEVERITY DETAILS DIAGNOSIS OF PROBLEM

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588    I     RSP      ARRAY NAME OPERAND NOT SUBSCRIPTED, FIRST ELEMENT WILL BE USED.
589    I     RSP      ARRAY NAME OPERAND NOT SUBSCRIPTED, FIRST ELEMENT WILL BE USED.
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82500

NOTE: These are program warning messages and appear throughout the program listing. They provide warnings only, and do not indicate program errors.

```
      SUBROUTINE EMOD(RSP,E,PS,PSI)                                      DH3/16   50
      COMMON/PSOL/NN,MM,NNPE,NDOF                                        DH3/16   51
      COMMON/FOILLY/IFOIL,NODFL                                          DH3/16   52
      COMMON/RT/RS1,RB,R0,T,RFF,RL                                       DH3/16   53
      COMMON/LOD/F(480,1),JDISP(30),S(6,6),RK(30,30),UR(160)             DH3/16   54
      COMMON/CURBMZ/TITLE(8),ICM(30),ENOA(10)                            DH3/16   55
      COMMON/PDEL/R(160),RF(162),URASS(10),RFREE(10)                     DH3/16   56
      COMMON/ECC/THETA(160)                                              DH3/16.  57
      COMMON/PLOTQ/IPLOT(2),IPRINT                                       DH4/14   13
      DIMENSIONRSP(160),A(1),B(1),C(2)                                   DH3/16   58
C     CALCULATE ANGLE TO EACH NODE                                       DH3/16   59
      RFOIL=IFOIL                                                        DH3/16   60
      DO 20 I=1,IFOIL                                                    DH3/16   61
      DO 10 J=1,NODFL                                                    DH3/16   62
      JI=(I-1)*NODFL+J                                                   DH3/16   63
      J1=J*NDOF-2                                                        DH3/16   64
      J2=J*NDOF-1                                                        DH3/16   65
      PHI=ENOA(J)+(I-1)*2.*3.14159/RFOIL                                 DH3/16   66
      DELR=URASS(J)+UR(JI)                                               DH3/16   67
      ZETA=0.                                                            DH4/5     5
      ANGLE=PHI+ZETA                                                     DH3/16   69
      THETA(JI)=ANGLE-PSI                                                DH3/16   70
      IF(IPRINT.EQ.0)GO TO 10                                            DH4/14   14
      WRITE(61,901)JI,ANGLE,PHI,ZETA,THETA(JI)                           DH3/16   71
  901 FORMAT(1H ,*NODE,ANGLE,PHI,ZETA,THETA=*,I3,4E15.5)                 DH3/16   72
   10 CONTINUE                                                           DH3/16   73
   20 CONTINUE                                                           DH3/16   74
C     CALCULATE MIN POSITION OF NODE                                     DH3/16   75
      DO 40 I=1,IFOIL                                                    DH3/16   76
      DO 40 J=1,NODFL                                                    DH3/16   77
      JI=(I-1)*NODFL+J                                                   DH3/16   78
      A(1)=-2.*E*COS(THETA(JI))                                          DH3/16   79
      B(1)=(2.*E*COS(THETA(JI)))**2-4.*(E**2-RS**2)                      DH3/16   80
      NV=1                                                               DH3/16   81
      NC=2                                                               DH3/16   82
      CALL QUAD(A,B,NV,C,NC,TER,NER)                                     DH3/16   83
      IF(NER.EQ.0)GO TO 50                                               DH3/16   84
C     IMAGINARYSOLUTION                                                  DH3/16   85
      WRITE(61,902)A,B,JI                                                DH3/16   86
  902 FORMAT(1H0,* IMAGINARY SOLUTION    A,B,NODE=   *,2E15.5,I5)        DH3/16   87
      CALL EXIT                                                          DH3/16   88
   50 CONTINUE                                                           DH3/16   89
      IF(C(1).GE.0..AND.C(2).GE.0.)GO TO 100                             DH3/16   90
C     ONE IS BAD                                                         DH3/16   91
      IF(C(1).LT.0.)K=2                                                  DH3/16   92
      IF(C(2).LT.0.)K=1                                                  DH3/16   93
      IF(C(1).LT.0..AND.C(2).LT.0.)GO TO 60                              DH3/16   94
      GO TO 110                                                          DH3/16   95
   60 CONTINUE                                                           DH3/16   96
C     NEITHER SOLUTION IS VALID                                          DH3/16   97
      WRITE(61,903)C(1),C(2),JI                                          DH3/16   98
  903 FORMAT(1H0,*NO SOLUTION FOR ECCENTRICITIES  C(1),C(2),NODE=*,      DH3/16   99
     *2E15.5,I5)                                                         DH3/16  100
      CALL EXIT                                                          DH3/16  101
  100 CONTINUE                                                           DH3/16  102
C     POSSIBLE BOTH ARE GOOD                                             DH3/16  103
      IF(C(1)/2..GT.RB-T.AND.C(2)/2..GT.RB-T)GO TO 60                    DH3/16  104
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92500

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      IF(C(1)/2..LE.RB-T)K=1                                          DH3/16   105
      IF(C(2)/2..LE.RB-T)K=2                                          DH3/16   106
  110 CONTINUE                                                        DH3/16   107
      RSP(JI)=C(K)/2.                                                 DH3/16   108
   40 CONTINUE                                                        DH3/16   109
      NODES=IFOIL*NODFL                                               DH3/16   110
      IF(IPRINT.EQ.0)GO TO 200                                        DH4/26     4
      WRITE(61,904)(I,RSP(I),I=1,NODES)                               DH3/16   111
  904 FORMAT(1H ,3(1X,*RSP(*,I3,*)= *,E15.6,3X))                      DH3/16   112
  200 CONTINUE                                                        DH4/26     5
      RETURN                                                          DH3/16   113
      END                                                             DH3/16   114
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62500

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      SUBROUTINE INVERT (S,M,ND,NERR)                                   PRELOD  577
C     INVERTS THE SYMMETRIC MATRIX S                                    PRELOD  578
      DIMENSION S(ND,ND)                                                PRELOD  579
C     M IS THE MATRIX SIZE                                              PRELOD  580
C     NERR IS AN ERROR INDICATOR -- 1= OK,   2= FAILURE                 PRELOD  581
   10 DO 110 J=1,M                                                      PRELOD  582
      IJ=J-1                                                            PRELOD  583
C     SWEEP OUT ALL ROWS EXCEPT PIVOTAL ROW J                           PRELOD  584
      XPIV=S(J,J)                                                       PRELOD  585
      IF (XPIV.EQ.0.)GO TO 130                                          PRELOD  586
      DO 90 I=1,M                                                       PRELOD  587
      IF (J-I)40,90,20                                                  PRELOD  588
   20 JC=J                                                              PRELOD  589
      AX=S(I,J)/XPIV                                                    PRELOD  590
      DO 30 K=1,I                                                       PRELOD  591
   30 S(I,K)=S(I,K)-AX*S(J,K)                                           PRELOD  592
   25 CONTINUE                                                          PRELOD  593
      GO TO 70                                                          PRELOD  594
   40 JC=I                                                              PRELOD  595
      AX=S(J,I)/XPIV                                                    PRELOD  596
      IF (IJ)70,70,50                                                   PRELOD  597
   50 DO 60 K=1,IJ                                                      PRELOD  598
   60 S(I,K)=S(I,K)-AX*S(J,K)                                           PRELOD  599
   70 DO 80 K=JC,M                                                      PRELOD  600
   80 S(I,K)=S(I,K)-AX*S(J,K)                                           PRELOD  601
      S(I,J)=-AX                                                        PRELOD  602
   90 CONTINUE                                                          PRELOD  603
C                                                                       PRELOD  604
C     SWEEP OUT PIVOTAL ROW J                                           PRELOD  605
C                                                                       PRELOD  606
      DO 100 K=1,M                                                      PRELOD  607
  100 S(J,K)=S(J,K)/XPIV                                                PRELOD  608
      S(J,J)=S(J,J)/XPIV                                                PRELOD  609
CCCCC IF ACCUMULATOR OVERFLOW 1017,1024                                 PRELOD  610
  110 CONTINUE                                                          PRELOD  611
      DO 120 I=1,M                                                      PRELOD  612
      DO 120 J=I,M                                                      PRELOD  613
  120 S(I,J)=S(J,I)                                                     PRELOD  614
      NERR=1                                                            PRELOD  615
      RETURN                                                            PRELOD  616
  130 NERR=2                                                            PRELOD  617
      RETURN                                                            PRELOD  618
      END                                                               PRELOD  619
```



82 55 00

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      SUBROUTINE FGEO(SA,R2,RNOT,IPASS)                                  FGEO      2
      REAL L                                                             FGEO      3
      COMMON/RT/RS1,RB,R0,T,RFF,RL                                       FGEO      4
      COMMON/FOILLY/IFOIL,NODEL                                          FGEO      5
      COMMON/GEO/ R12(2),ROE(2),BETAP(2),L(4),GAMA(4),R2P(8),A(4),B(4),  FGEO      6
     +KEY(8),KEYL(4),IER(8)                                              FGEO      7
      COMMON/PLOTQ/IPLOT(2),IPRINT                                       DH4/22   17
      DIMENSION ALPHA(2)                                                 FGEO      8
C INITIALIZE DATA                                                        FGEO      9
      ALFAC=1.                                                           FGEO     10
      IF(IPASS.EQ.1)ALFAC=10.                                            FGEO     11
      RBT=RB-T                                                           FGEO     12
      IDIR=0                                                             FGEO     13
      DELA=.05                                                           FGEO     14
      IBAD1=0                                                            FGEO     15
      IBAD2=0                                                            FGEO     16
      RFOIL=IFOIL                                                        FGEO     17
      RNOTSV=0.                                                          DH4/16    1
      RF=RNOT                                                            DH4/20   11
      F=1.                                                               FGEO     19
      C1=2.*3.14159/RFOIL                                                FGEO     20
    5 ALPHA(1)=(90.-180./RFOIL)*3.14159/180.                             FGEO     21
      IF(IPASS.EQ.1)ALPHA(1)=0.025                                       DH4/12    1
      ALPHA(2)=ALPHA(1)+DELA*ALPHA(1)                                    FGEO     22
      IF(IPRINT.EQ.0)GO TO 10                                            DH4/22   18
      WRITE(61,501)IFOIL,RL,T,RBT,RFF                                    FGEO     23
   10 RNOT=RF                                                            DH4/19    2
      IF(IDIR.GE.2)IDIR=0                                                FGEO     25
      IDIR=1                                                             DH4/16    2
      IF(IBAD1.EQ.1)IDIR=2                                               FGEO     27
      IF(IBAD2.EQ.2)IDIR=1                                               FGEO     28
C     IF(IDIR.EQ.1)WRITE(61,630)                                         FGEO     29
C     IF(IDIR.EQ.2)WRITE(61,635)                                         FGEO     30
      IF(ALPHA(IDIR).LE..02.OR.ALPHA(IDIR).GE.3.14159265)GO TO 2000      FGEO     31
   11  THETA=RL/RNOT                                                     FGEO     32
      CALL MEMSET(R12(1),IER(8),0.)                                      FGEO     33
      RLF=2.*RNOT*SIN(THETA/2.)                                          FGEO     34
      IF(THETA-(ALPHA(IDIR)+2.*3.14159265/RFOIL))30,30,20                FGEO     35
   20 ALPHA(IDIR)=ALPHA(IDIR)+DELA/(F*ALFAC)*ALPHA(IDIR)                 DH4/16    3
      IF(IDIR.GE.2)IDIR=0                                                FGEO     37
      GO TO 10                                                           FGEO     38
   30 R2A=RBT*COS(C1*ALPHA(IDIR)))**2-(RBT**2-RLF**2)                    FGEO     39
      R2B=(RBT*COS(C1*ALPHA(IDIR)))**2-(RBT**2-RLF**2)                   FGEO     40
      IF(IPASS.EQ.1.AND.RNOT.NE.RF)GO TO 20                              DH4/19    3
      CALL QUAD(R2A,R2B,1,R12,2,IER,NER)                                 FGEO     42
C     WRITE(61,510)ALPHA(IDIR),THETA,RLF,RNOT                            FGEO     43
C     WRITE(61,520)R12                                                   FGEO     44
C     IF(NER.NE.0)WRITE(61,530)IER                                       FGEO     45
C CHECK TO SEE IF R2 VALUES ARE VALID                                    FGEO     46
      DO 31 I=1,2                                                        FGEO     47
      IF(R12(I).GT.0..AND.R12(I).LE.RBT)KEY(I)=I                         FGEO     48
   31 CONTINUE                                                           FGEO     49
      DO 35 I=1,2                                                        FGEO     50
      IF(KEY(I)-1)35,40,40                                               FGEO     51
C     WRITE(61,525)                                                      FGEO     52
   35 CONTINUE                                                           FGEO     53
      RNOT=.99*RNOT                                                      FGEO     54
```



0 0 0 0 0 0 0

```
                GO TO 11
             40 K=0
60                DO 50 I=1,2
                  IF(KEY(I).EQ.0)GO TO 50
                  K=K+1
                  ROE(K)=ASIN(R12(I)/RNOT*SIN(C1/2.))
             50   CONTINUE
65           C    WRITE(61,540)ROE
                  K=0
                  DO 60 I=1,2
                  IF(KEY(I).EQ.0)GO TO 60
                  K=K+1
70                BETAP(K)=THETA-ROE(K)
                  B(K)=(RNOT*COS(BETAP(K)))**2-(RNOT**2-RBT**2)
                  A(K)=RNOT*COS(BETAP(K))
             60   CONTINUE
                  J=2*K
75                CALL QUAD(A,B,K,L,J,IER,NER)
             C    WRITE(61,550)L
             C    IF(NER.NE.0)WRITE(61,530)IER
                  IF(2*NER-J)80,70,70
             70   CONTINUE
80           C NO REAL VALUES OF L EXIST
                  RNOT=(1.-.005/F)*RNOT
                  GO TO 11
             80   N=K**2-2*NER
                  K=0
85                DO 90 I=1,N
                  IF(L(I).LE.0.)KEYL(I)=1
                  IF(IER(I).NE.0)GO TO 90
                  IF(L(I).LE.0.)GO TO 90
                  K=K+1
90                GAMA(K)=ACOS((-(RNOT)**2+RBT**2+L(I)**2)/(2.*RBT*L(I)))
             90   CONTINUE
                  IF(K-1)95,96,96
             95   CONTINUE
             C NO REAL VALUES OF L
95                RNOT=(1.-.005/F)*RNOT
                  GO TO 11
             96   CONTINUE
             C    WRITE(61,560)GAMA
                  KK=0
100               DO 100 I=1,N
                  IF(IER(I).NE.0)GOTO 100
                  IF(L(I).LE.0.)GO TO 100
                  KK=KK+1
                  A(KK)=L(I)*COS(ALPHA(IDIR)+GAMA(KK))
105               B(KK)=A(KK)**2-(L(I)**2-RNOT**2)
            100   CONTINUE
            610   FORMAT(1H0,4E11.4,5X,4E11.4)
                  J=2*KK
                  CALL QUAD(A,B,KK,R2P,J,IER,NER)
110          C    WRITE(61,570)R2P
             C    IF(NER.NE.0)WRITE(61,530)IER
             C CHECK R2P AGAINST R12
                  E=3.*T/F**5
                  ERRMIN=100.
```

```
FGEO    55
FGEO    56
FGEO    57
FGEO    58
FGEO    59
FGEO    60
FGEO    61
FGEO    62
FGEO    63
FGEO    64
FGEO    65
FGEO    66
FGEO    67
FGEO    68
FGEO    69
FGEO    70
FGEO    71
FGEO    72
FGEO    73
FGEO    74
FGEO    75
FGEO    76
FGEO    77
FGEO    78
FGEO    79
FGEO    80
FGEO    81
FGEO    82
FGEO    83
FGEO    84
FGEO    85
FGEO    86
FGEO    87
FGEO    88
FGEO    89
FGEO    90
FGEO    91
FGEO    92
FGEO    93
FGEO    94
FGEO    95
FGEO    96
FGEO    97
FGEO    98
FGEO    99
FGEO   100
FGEO   101
FGEO   102
FGEO   103
FGEO   104
FGEO   105
FGEO   106
FGEO   107
FGEO   108
FGEO   109
OM4/20  12
FGEO   111
```

161

0 0 5 9 4 9

```
                      DO 122 LK=1,2                                                  FGEO     112
                      IF(KEY(LK).EQ.0)GO TO 122                                      FGEO     113
                      DO 120 M=1,KK                                                  FGEO     114
                      DO 120 N=1,2                                                   FGEO     115
                      IF(N.EQ.1)I=M                                                  FGEO     116
  120                 IF(N.EQ.2)I=M+KK                                               FGEO     117
                      IF(R2P(I).LE.0.)GO TO 120                                      FGEO     118
                      ERR1=ABS(R2P(I)-(R12(LK)+T))                                   FGEO     119
                      ERR2=ABS(R2P(I)-(R12(LK)+T))                                   FGEO     120
                      ERR=AMAX1(ERR1,ERR2)                                           FGEO     121
  125                 IF(ERR.GT.ERRMIN)GO TO 120                                     FGEO     122
                      ERRMIN=ERR                                                     FGEO     123
                      IR2P=I                                                         FGEO     124
                      IR12=LK                                                        FGEO     125
                      K=0                                                            FGEO     126
  130                 DO 119 J=1,4                                                   FGEO     127
                      IF(KEYL(J).EQ.1)GO TO 119                                      FGEO     128
                      K=K+1                                                          FGEO     129
                      IF(K-M)119,118,119                                             FGEO     130
                118   IL=J                                                           FGEO     131
  135                 GO TO 120                                                      FGEO     132
                119   CONTINUE                                                       FGEO     133
                120   CONTINUE                                                       FGEO     134
                122   CONTINUE                                                       FGEO     135
                      IF(RNOT.EQ.RNOTSV)GO TO 123                                    DH4/16     4
  140                 IF(IPRINT.EQ.0)GO TO 123                                       DH4/22    19
                      WRITE(61,641)RNOT                                              DH4/16     5
                      WRITE(61,645)                                                  FGEO     138
                      WRITE(61,655)                                                  FGEO     139
                123   CONTINUE                                                       FGEO     140
  145                 RNOTSV=RNOT                                                    DH4/16     6
                      IF(IPRINT.EQ.0)GO TO 124                                       DH4/22    20
                      WRITE(61,650)ALPHA(IDIR),R12(IR12),R2P(IR2P),L(IL),THETA,RLF,  DH4/16     7
                     +ERRMIN                                                         DH4/16     8
                  124 CONTINUE                                                       DH4/22    21
  150                 IF(R2P(IR2P).LE.R12(IR12)+T+E.AND.R2P(IR2P).GE.R12(IR12)+T-E    FGEO     143
                     +.AND.R2P(IR2P).GT.0.)GO TO 900                                 FGEO     144
                C VALUES OF R2 DO NOT MATCH                                          FGEO     145
                      IF(F.EQ.1.)GO TO 121                                           FGEO     146
                      F=1.                                                           FGEO     147
  155                 E=3.*T/F**5                                                    DH4/20    13
                      IF(R2P(IR2P).LE.R12(IR12)+T+E.AND.R2P(IR2P).GE.R12(IR12)+T-E.AND. FGEO   149
                     +R2P(IR2P).GT.0.)GO TO 1000                                     FGEO     150
                130   CONTINUE                                                       FGEO     151
                      IF(IPRINT.EQ.0)GO TO 121                                       DH4/22    22
  160                 WRITE(61,620)                                                  FGEO     152
                121   RNOT=(1.-.005/F)*RNOT                                          FGEO     153
                      GO TO 11                                                       FGEO     154
                  900 IF(F.EQ.1..AND.IPRINT.NE.0)WRITE(61,620)                       DH4/22    23
                1000  CONTINUE                                                       FGEO     156
  165                 F=2.                                                           FGEO     157
                      E=3.*T/F**5                                                    DH4/20    14
                      IF(R2P(IR2P).LE.R12(IR12)+T+E.AND.R2P(IR2P).GE.R12(IR12)+T-E.AND.R FGEO   159
                     +2P                                                             FGEO     160
                     +(IR2P).GT.0.)GO TO 1100                                        FGEO     161
  170                 RNOT=(1.-.005/F)*RNOT                                          FGEO     162
                      GO TO 11                                                       FGEO     163
```



625 00

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      1100  CONTINUE                                                          FGEO     164
            WRITE(61,656)                                                     DH4/22    24
            WRITE(61,580)                                                     FGEO     165
  175       IF(IPRINT.NE.0)WRITE(61,590)R2P(IR2P),E                           DH4/26     6
            WRITE(61,642)RNOT                                                 DH4/26     7
            R2=R12(IR12)                                                      FGEO     167
            SA=ASIN(R2/RNOT*SIN(C1/2.))                                       FGEO     168
            IPASS=3                                                           FGEO     169
  180   1111  CONTINUE                                                        FGEO     170
            RETURN                                                            FGEO     171
       2000 CONTINUE                                                          DH4/23    39
            IF(IPRINT.EQ.0)GO TO 2001                                         DH4/23    40
            WRITE(61,600)                                                     DH4/23    41
  185       WRITE(61,640)ALPHA(IDIR)                                          FGEO     173
       2001 CONTINUE                                                          DH4/23    42
            RF=(1.-0.005/F)*RF                                                DH4/19     4
            IF(RF.GT.1.)GO TO 5                                               DH4/19     5
            IBAD2=2                                                           DH4/16    11
  190       IF(IDIR.EQ.1)IBAD1=1                                              FGEO     174
            IF(IDIR.EQ.2)IBAD2=2                                              FGEO     175
            IF(IBAD1.EQ.1.AND.IBAD2.EQ.2)GO TO 1111                           FGEO     176
            GO TO 10                                                          FGEO     177
        501 FORMAT(1H0,*FOILS,ARCL,F,RBT,RFF = *,I8,3X,4(F10.4,1X))           DH4/22    26
  195   510   FORMAT(1H0,*ALPHA,THETA,LF,RNOT = *,4F10.4)                     FGEO     179
        520   FORMAT(1H0,*VALUES OF R2 *,/,1X,2(E11.4,2X))                    FGEO     180
        530   FORMAT(1H ,*THE FOLLOWING ELEMENTS OF THE ABOVE ARRAY ARE IMAINARY FGEO   181
             +*,3X,8(I2,2X))                                                  FGEO     182
        525   FORMAT(1H ,*THIS CALCULATED VALUE OF R2 IS NOT VALID*)          FGEO     183
  200   540   FORMAT(1H0,*VALUES OF ROE *,/,1X,2(E11.4,2X))                   FGEO     184
        550   FORMAT(1H0,*VALUES OF L *,/,1X,4(E11.4,2X))                     FGEO     185
        560   FORMAT(1H0,*VALUES OF GAMMA *,/,1X,4(E11.4,2X))                 FGEO     186
        570   FORMAT(1H0,*VALUES OF R2PRIME */,1X,8(E11.4,2X))                FGEO     187
        580 FORMAT(1H0,*THIS IS A CONVERGED CASE, YOU LUCKY DOG*,/,1X,        DH4/22    27
  205      +*FOIL GEOMETRY GIVES THE FOLLOWING VALUES FOR THE ASSEMBLY *     DH4/22    28
            +*POSITION.*)                                                     DH4/22    29
        590   FORMAT(1H ,*R2=*,E11.4,* +/- *,E11.4)                           FGEO     189
        600   FORMAT(1H0,*NO SOLUTION WITH THESE VALUES*)                     FGEO     190
        620   FORMAT(1H0,132(1H*))                                            FGEO     191
  210   630   FORMAT(1H0,*DECREASING ALPHA*,100(1H-))                         FGEO     192
        635   FORMAT(1H0,*INCREASING ALPHA*,100(1H-))                         FGEO     193
        640   FORMAT(1H0//,1H0,*ALPHA= *,E11.4)                               FGEO     194
        641 FORMAT(1H0//,1H0,*RNOT= *,E11.4)                                  DH4/16    12
        642 FORMAT(1H0,//,1X,*RADIUS OF CURVATURE AT ASSEMBLY POSITION = *,   DH4/26     8
  215      +E11.4)                                                           DH4/26     9
        645 FORMAT(1H0,18X,*ALPHA*,8X,*R2*,10X,*R2PRIME*,6X,*L*,12X,*THETA*   DH4/16    13
             +,8X,*LF*,11X,*ERROR*)                                           FGEO     196
        650   FORMAT(1H ,15X,7(E11.4,2X))                                     FGEO     197
        655   FORMAT(1H ,14X,89(1H*))                                         FGEO     198
  220   656 FORMAT(1H0,///,1X,125(1H*),/,1X,*FOIL BEARING ASSEMBLY GEOMETRY*) DH4/22    30
            END                                                               FGEO     199
```

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62500

```
      SUBROUTINE QUAD(A,B,NV,C,NC,IER,NER)                          QUAD    2
      DIMENSION A(NV),B(NV),C(NC),IER(NC)                           QUAD    3
      CALL MEMSET(IER(1),IER(NC),0)                                 QUAD    4
      NER=0                                                         QUAD    5
      DO 10 L=1,NV                                                  QUAD    6
      IF(B(L))5,10,10                                               QUAD    7
    5 IER(L)=L                                                      QUAD    8
      NER=NER+1                                                     QUAD    9
      B(L)=-B(L)                                                    QUAD   10
   10 B(L)=SQRT(B(L))                                               QUAD   11
      K=1                                                           QUAD   12
  100 FORMAT(1H0,4E11.4,5X,4E11.4)                                  QUAD   13
      DO 20 I=1,2                                                   QUAD   14
      DO 20 J=1,NV                                                  QUAD   15
      IF(J.EQ.IER(J))GO TO 20                                       QUAD   16
      C(K)=A(J)+(-1.)**I*B(J)                                       QUAD   17
   20 K=K+1                                                         QUAD   18
      RETURN                                                        QUAD   19
      END                                                           QUAD   20
```



625 00

```
      SUBROUTINE SHAFTBC(RP,RINIT,RFINAL,DELR,RMINF,KEC,ICHNG)          DH3/24     6
      COMMON/FOILLY/IFOIL,NODFL                                         SHAFTBC    3
      COMMON/PDEL/R(160),RF(160)                                        SHAFTBC    4
      COMMON/PDDISP/NDDISP,I1DDSP(160),I2DDSP(160)                      SHAFTBC    5
      COMMON/SET/NODSET(160),NNODST                                     SHAFTBC    6
      COMMON/RCP/NODES,NELEM,KODERC(160)                                SHAFTBC    7
      COMMON/PLOTQ/IPLOT(2),IPRINT                                      DH4/14    15
      DIMENSION RP(1)                                                   DH3/16   116
C                                                                       SHAFTBC    8
C     FIND NODE WITHMINIMUM RADIUS                                      SHAFTBC    9
      RMINF=RF(1)                                                       SHAFTBC   10
      DO 1000 K=1,IFOIL                                                 SHAFTBC   11
      I1=(K-1)*NODFL+2                                                  SHAFTBC   12
      I2=K*NODFL                                                        SHAFTBC   13
      I3=(K-1)*NODFL+1                                                  SHAFTBC   14
      RMIN=RF(I3)                                                       SHAFTBC   15
      IMIN=I3                                                           SHAFTBC   16
      DO 110 I=I1,I2                                                    SHAFTBC   17
      IF(RF(I).GE.RMIN)GO TO 110                                        SHAFTBC   18
      IMIN=I                                                            SHAFTBC   19
      RMIN=RF(I)                                                        SHAFTBC   20
  110 CONTINUE                                                          SHAFTBC   21
      IF(RMIN.GE.RFINAL)GO TO 1000                                      SHAFTBC   22
      IF(RINIT.NE.0..AND.RMIN.GE.RINIT)GO TO 1000                       SHAFTBC   23
      RP=RINIT                                                          SHAFTBC   24
      IF(RINIT.EQ.0.)RP=RMIN+DELR                                       SHAFTBC   25
C     CONSTRAIN NODE                                                    SHAFTBC   26
C       CHECK FOR DEP. NODE                                             SHAFTBC   27
      DO 200 N=1,NDDISP                                                 SHAFTBC   28
      IF(IMIN.NE.I1DDSP(N))GO TO 200                                    SHAFTBC   29
      IMIN=IABS(I2DDSP(N))                                              SHAFTBC   30
  200 CONTINUE                                                          SHAFTBC   31
      NNODST=NNODST+1                                                   SHAFTBC   32
      NODSET(IMIN)=IMIN                                                 SHAFTBC   33
      IF(IPRINT.NE.0)WRITE(61,800)IMIN                                  DH4/24    12
  800 FORMAT(1H ,*NODE *,I3,* SET*)                                     SHAFTBC   35
      CALL PACK60(KODERC(IMIN),1,2)                                     SHAFTBC   36
      IF(RMIN.GE.RMINF)GO TO 1000                                       SHAFTBC   37
      RMINF=RMIN                                                        SHAFTBC   38
 1000 CONTINUE                                                          SHAFTBC   39
      RETURN                                                            SHAFTBC   40
C                                                                       SHAFTBC   41
C                                                                       SHAFTBC   42
      ENTRY SHAFT2                                                      SHAFTBC   43
C     FIND NODES WITH MINIMUM RADIUS                                    SHAFTBC   44
      ICHNG=0                                                           SHAFTBC   45
      QP=RP(1)                                                          DH3/24     7
      IF(KEC.EQ.0)CALL MEMSET(RP(1),RP(160),QP)                         DH3/24     8
      DO 1600 J=1,IFOIL                                                 SHAFTBC   46
      I1=(J-1)*NODFL+NODFL/2+1                                          DH3/24     9
      I2=J*NODFL                                                        SHAFTBC   48
      I3=(J-1)*NODFL+1                                                  SHAFTBC   49
      RMIN=0.                                                           DH3/24    10
      IMIN=I1                                                           DH3/24    11
      IMIND=I1                                                          DH3/24    12
      DO 1500 I=I1,I2                                                   SHAFTBC   52
      RESP=RF(I)-RP(I)                                                  DH3/24    13
```



0 0 5 2 3

```
                      IF(RFSP.GE.0)GO TO 1500                                  DH3/24    14
                      IF(RFSP.GE.RMIN)GO TO 1500                               DH3/24    15
                      K=I                                                      SHAFTBC   54
60                    C  CHECK FOR DEP NODE                                    SHAFTBC   55
                      DO 1200 N=1,NODISP                                       SHAFTBC   56
                      IF(I.EQ.I1DDSP(N))K=IABS(I2DDSP(N))                      SHAFTBC   57
                 1200 CONTINUE                                                 SHAFTBC   58
65                    IMIN=K                                                   SHAFTBC   59
                      IMIND=I                                                  DH3/24    16
                      RMIN=RFSP                                                DH3/24    17
                 1500 CONTINUE                                                 SHAFTBC   61
                      IF(IPRINT.NE.0)WRITE(61,1031)IMIN,NODSET(IMIN)           DH4/14    16
70               1031 FORMAT(1H0,*NODSET(*,I3,*)=*,I3)                         SHAFTBC   63
                      IF(NODSET(IMIN).EQ.-IMIN)GO TO 1600                      DH3/30     7
                      IF(RF(IMIND).GE.RP(IMIND))GO TO 1600                     DH3/24    18
                      ICHNG=1                                                  SHAFTBC   65
                      NNODST=NNODST+1                                          SHAFTBC   66
75                    NODSET(IMIN)=-IMIN                                       DH3/30     8
                      IF(IPRINT.NE.0)WRITE(61,800)IMIN                         DH4/24    13
                      CALL PACK60(KODEBC(IMIN),1,2)                            SHAFTBC   69
                 1600 CONTINUE                                                 SHAFTBC   70
                      IF(REC.EQ.1)GO TO 1510                                   DH3/16   117
80                    IF(RP.GT.RFINAL)RP=RFINAL                                SHAFTBC   71
                 1510 CONTINUE                                                 SHAFTBC   72
                      RETURN                                                   SHAFTBC   73
                      END                                                      SHAFTBC   74
```

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CARD NR. SEVERITY DETAILS DIAGNOSIS OF PROBLEM

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 25    I     RP      ARRAY NAME OPERAND NOT SUBSCRIPTED, FIRST ELEMENT WILL BE USED.
 26    I     RP      ARRAY NAME OPERAND NOT SUBSCRIPTED, FIRST ELEMENT WILL BE USED.
 48    I     RP      ARRAY REFERENCE OUTSIDE DIMENSION BOUNDS.
 80    I     RP      ARRAY NAME OPERAND NOT SUBSCRIPTED, FIRST ELEMENT WILL BE USED.
 80    I     RP      ARRAY NAME OPERAND NOT SUBSCRIPTED, FIRST ELEMENT WILL BE USED.
```

0 0 5 2 3 6

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      OVERLAY(ISOFP1,6,1)                                                    ASSMBG     2
      PROGRAM ASSMBG                                                         ASSMBG     3
C                                                                            ASSMBG     4
C     GENERAL ASSEMBLY ROUTINE TO COMBINE ELEMENT STIFFNESS MATRICES         ASSMBG     5
C         INTO BLOCKS FOR SOLUTION BY SUBROUTINE SYMSOL                      ASSMBG     6
C     UPPER SYMMETRIC HALF OF SYSTEM MATRIX WILL BE ASSEMBLED, PLUS          ASSMBG     7
C           LOWER HALF OF THOSE BLOCKS ON THE DIAGONAL                       ASSMBG     8
C                                                                            ASSMBG     9
C     NS    = ORDER OF BLOCK SIZE FOR SYMSOL                                 ASSMBG    10
C     NN    = NO. OF BLOCKS ON DIAGONAL                                      ASSMBG    11
C     MM    = NO. OF BLOCKS PER ROW                                          ASSMBG    12
C             MM .LE. NN                                                     ASSMBG    13
C     NELEM= NO. OF ELEMENTS                                                 ASSMBG    14
C     NODES= NO. OF NODES                                                    ASSMBG    15
C     NNPE  = NO. OF NODES PER ELEMENT                                       ASSMBG    16
C     NDOF  = NO. OF DEGREES OF FREEDOM PER NODE                             ASSMBG    17
C     LUE   = UNIT NUMBER WHERE ELEMENT STIFFNESS MATRICES ARE STORED        ASSMBG    18
C     LUK   = UNIT NUMBER WHERE BLOCKS ARE TO BE STORED                      ASSMBG    19
C     NSTF = NNPE * NDOF = ORDER OF ELEMENT STIFFNESS MATRICES               ASSMBG    20
C     NEQ= NODES * NDOF = TOTAL NO. OF EQUATIONS IN SYSTEM                   ASSMBG    21
C     NN= (NEQ + NS - 1 ) / NS                                               ASSMBG    22
C     NW= MAX. DIFFERENCE BETWEEN NODE NOS. OF AN ELEMENT                    ASSMBG    23
C     NBAND= (NW + 1 ) * NDOF = MATRIX HALF-BAND WIDTH                       ASSMBG    24
C     FOR UNBANDED SYSTEM, FOLLOWING FORMULA GIVES MM= NN+1, RESET MM=NN     ASSMBG    25
C     MM= (NBAND - NDOF - 1 ) / NS + 2                                       ASSMBG    26
C     NRECRD= ( NN * ( NN + 1 ) ) / 2 = NO. OF POSSIBLE BLOCKS (RECORDS)     ASSMBG    27
C     NOTE-- UNLESS MM= NN , MOST BLOCKS WILL BE ALL 0. AND WILL             ASSMBG    28
C              NOT  BE WRITTEN TO DISK OR ACCESSED BY SYMSOL                 ASSMBG    29
C     NOTE-- NS MUST BE A MULTIPLE OF NDOF                                   ASSMBG    30
C                                                                            ASSMBG    31
C*    GIVEN NODES= 450 MAX., AND NDOF= 6 MAX., (AND ALLOWING FOR NDOF=2      ASSMBG    32
C*         OR NDOF=3) , THEN NS= 36 MINIMIZES THE STORAGE REQUIRED FOR       ASSMBG    33
C*         SYMSOL                                                            ASSMBG    34
C                                                                            ASSMBG    35
C     ARRAYS MUST HAVE DIMENSIONS--                                          ASSMBG    36
C         A(NS,NS), LM(NNPE), NB(NELEM,NNPE),     S(NSTF,NSTF)               ASSMBG    37
C         KRECRD(NRECRD)                                                     ASSMBG    38
C                                                                            ASSMBG    39
      COMMON/BCP/NODES,NELEM,KODEBC(160),FDZ(160),FDR(160),NW                ASSMBG    40
      COMMON /SYMSL1/ A(12,12)                                               ASSMBG    41
      COMMON/SYMSL2/S(6,6)                                                   ASSMBG    42
      COMMON /SYMSL3/ B(12)                                                  ASSMBG    43
      DIMENSION C(12,12)                                                     ASSMBG    44
      DIMENSION LM(4),U(2)                                                   ASSMBG    45
      COMMON/PSOL/NN,MM,NNPE,NDOF,NVECT,LUK,LUR,INDEX17(821),INDEX19(41)     ASSMBG    46
     *,KRECRD(820),NEQ                                                       ASSMBG    47
      COMMON/PDDISP/NDDISP,I1DDSP(160),I2DDSP(160),DDISPY(160),DDISPX(16     ASSMBG    48
     *0)                                                                     ASSMBG    49
      COMMON/CURRM7/DUM(198),NB(145,2)                                       ASSMBG    50
      COMMON/NSX/NS                                                          ASSMBG    51
      COMMON/FOILLY/IFOIL,NODEL                                              ASSMBG    52
      COMMON/SYMSOL/DUD(7),LUE,LUX,INDEX3(41),INDEX7(146)                    ASSMBG    53
C                                                                            ASSMBG    54
      NRCD(I,J)=((I+J)*(I+J-1))/2-J+1                                        ASSMBG    55
C                                                                            ASSMBG    56
C                                                                            ASSMBG    57
C                                                                            ASSMBG    58
```



S2 55 0 0

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      C     IF THERE ARE CYCLO OR DUISP NODAL PAIRS, THEY MUST BE ORDERED SO   ASSMBG     59
      C           THAT  I1XXXX .LT. I2XXXX , AND, ANY LOADING ON NODE I1XXXX   ASSMBG     60
   60 C           MUST BE ADDED TO I2XXXX.  THIS IS ASSUMED TO HAVE BEEN DONE  ASSMBG     61
      C           PRIOR TO ENTRY HERE.                                         ASSMBG     62
      C     SET DEPENDENT FREEDOMS TO BE RESTRAINED FROM SYSTEM                ASSMBG     63
         12 IF (NODISP .EQ. 0) GO TO 15                                        ASSMBG     64
            DO 14 I=1,NODISP                                                   ASSMBG     65
   65       N= IABS(I1DDSP(I))                                                 ASSMBG     66
            IF(N.EQ.0)GO TO 14                                                 ASSMBG     67
            IF (I1DDSP(I) .GT. 0) GO TO 13                                     ASSMBG     68
            CALL PACK60 (KODEBC(N), 1, 1 )                                     ASSMBG     69
            FDZ(N)= 0.                                                         ASSMBG     70
   70       13 IF (I2DDSP(I) .GT. 0) GO TO 14                                  ASSMBG     71
            CALL PACK60 (KODEBC(N), 1, 2 )                                     ASSMBG     72
            FDR(N)= 0.                                                         ASSMBG     73
         14 CONTINUE                                                           ASSMBG     74
         15 CONTINUE                                                           ASSMBG     75
   75 C                                                                        ASSMBG     76
            BIGNO=1.E30                                                        ASSMBG     77
            NSIZE=NS*NS                                                        ASSMBG     78
      C     NOTE-- NNPE= 4 HERE, WHETHER THERE ARE TRIANGLES OR NOT            ASSMBG     79
            NSTF=NDOF*NNPE                                                     ASSMBG     80
   80 C     UNPACK NODE NOS. OF ELEMENTS TO NB ARRAY ONCE                      ASSMBG     81
            NSTF2=NSTF*NSTF                                                    ASSMBG     82
      C     NDEL IS THE NO. OF NODES WITHIN ONE BLOCK, LESS 1                  ASSMBG     83
            NDEL=NS/NDOF-1                                                     ASSMBG     84
            NR1=1                                                              ASSMBG     85
   85 C* * SET FLAGS FOR ZERO BLOCKS                                           ASSMBG     86
            CALL MEMSET(KRECRD,KRECRD(820),0)                                  ASSMBG     87
            ISHIFT=0                                                           ASSMBG     88
      C     NELINC IS THE NUMBER OF THE ELEMENT STIFFNESS IN CORE              ASSMBG     89
            NELINC=0                                                           ASSMBG     90
   90 C     INITIALIZE BLOCK                                                   ASSMBG     91
            DO 40 I1=1,NSIZE                                                   ASSMBG     92
         40 A(I1)=0.                                                           ASSMBG     93
            KMM=MM                                                             ASSMBG     94
            NNMMP1=NN-MM+1                                                     ASSMBG     95
   95       DO 340 I=1,NN                                                      ASSMBG     96
            NR2=NR1+NDEL                                                       ASSMBG     97
         41 FORMAT(1H0,*I=*,I3,5X,*NR1=*,I3,5X,*NR2=*,I3)                      ASSMBG     98
            NC1=NR1                                                            ASSMBG     99
            JSHIFT=ISHIFT                                                      ASSMBG    100
  100       IF (I.GT.NNMMP1) KMM=KMM-1                                         ASSMBG    101
            DO 50 K=1,NS                                                       ASSMBG    102
         50 B(K)=0.                                                            ASSMBG    103
            DO 210 J=1,KMM                                                     ASSMBG    104
            NC2=NC1+NDEL                                                       ASSMBG    105
  105 C     NTK IS THE BLOCK NUMBER (AND RECORD NO. ON DISK)                   ASSMBG    106
            NTK=NRCD(I,J)                                                      ASSMBG    107
            NTK1=MOD(NTK,60)                                                   ASSMBG    108
            IF (NTK1.EQ.0) NTK1=60                                             ASSMBG    109
            NTK2=(NTK-1)/60+1                                                  ASSMBG    110
  110       42 FORMAT(1H0,*J=*,I3,5X,*NTK=*,I3,5X,*NTK1=*,I3,5X,*NTK2=*,I3)    ASSMBG    111
            DO 130 K=1,NELEM                                                   ASSMBG    112
      C     CHECK IF ELEMENT K WILL CONTRIBUTE ANYTHING TO THIS BLOCK          ASSMBG    113
            IFLAG=0                                                            ASSMBG    114
            JFLAG=0                                                            ASSMBG    115
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0 0 5 2 3 0

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115               DO 60 L=1,NNPE                                                ASSMBG  116
                  LL=NB(K,L)                                                    ASSMBG  117
                  IF (LL.GE.NR1.AND.LL.LE.NR2) IFLAG=1                          ASSMBG  118
                  IF (LL.GE.NC1.AND.LL.LE.NC2) JFLAG=1                          ASSMBG  119
               60 CONTINUE                                                      ASSMBG  120
120         61    FORMAT(1H0,*IFLAG=*,I3,3X,*JFLAG=*,I3)                        ASSMBG  121
                  IF (IFLAG+JFLAG.NE.2) GO TO 130                               ASSMBG  122
            C     SET FLAG FOR THIS BLOCK NOT BEING ALL ZEROS                   ASSMBG  123
            62    FORMAT(1H ,*LL=*,I3,5X,*SET FLAG FOR THIS BLOCK NOT ALL 0+S*) ASSMBG  124
                  CALL PACK60 (KRECRD(NTK2),1,NTK1)                             ASSMBG  125
125               DO 70 L=1,NNPE                                                ASSMBG  126
               70 LM(L)=NDOF*(NB(K,L)-1)                                        ASSMBG  127
                  IF (K.EQ.NELINC) GO TO 80                                     ASSMBG  128
                  NELINC=K                                                      ASSMBG  129
            C     READ ELEMENT STIFFNESS MATRIX FROM DISK                       ASSMBG  130
130         44    FORMAT(1H0,*S MATRIX READ IN HERE*)                           ASSMBG  131
                  CALL READMS (LUE,S,NSIF2,K)                                   ASSMBG  132
            C     ADD IN ELEMENT STIFFNESS MATRIX                               ASSMBG  133
               80 IIS=1                                                         ASSMBG  134
                  DO 120 II=1,NNPE                                              ASSMBG  135
135         C **  CHECK FOR TRIANGLE                                            ASSMBG  136
                  IF (LM(II).LT.0) GO TO 120                                    ASSMBG  137
                  IIA=LM(II)-ISHIFT+1                                           ASSMBG  138
            C     CHECK IF ROW OF BLOCK IS VALID                                ASSMBG  139
                  IF (IIA.LT.1.OR.IIA.GT.NS) GO TO 120                          ASSMBG  140
140               JJS=1                                                         ASSMBG  141
                  DO 110 JJ=1,NNPE                                              ASSMBG  142
            C **                                                                ASSMBG  143
                  IF (LM(JJ).LT.0) GO TO 110                                    ASSMBG  144
                  JJA=LM(JJ)-JSHIFT+1                                           ASSMBG  145
145         C     CHECK IF COL OF BLOCK IS VALID                                ASSMBG  146
                  IF (JJA.LT.1.OR.JJA.GT.NS) GO TO 1[illegible]                 ASSMBG  147
                  III=IIA                                                       ASSMBG  148
                  KKK=IIS                                                       ASSMBG  149
                  DO 100 KK=1,NDOF                                              ASSMBG  150
150               JJJ=JJA                                                       ASSMBG  151
                  LLL=JJS                                                       ASSMBG  152
                  DO 90 LL=1,NDOF                                               ASSMBG  153
                  A(III,JJJ)=A(III,JJJ)+S(KKK,LLL)                              ASSMBG  154
                  LLL=LLL+1                                                     ASSMBG  155
155            90 JJJ=JJJ+1                                                     ASSMBG  156
                  KKK=KKK+1                                                     ASSMBG  157
              100 III=III+1                                                     ASSMBG  158
              110 JJS=JJS+NDOF                                                  ASSMBG  159
              120 IIS=IIS+NDOF                                                  ASSMBG  160
160           130 CONTINUE                                                      ASSMBG  161
            C     BLOCK IS COMPLETE WITH RESPECT TO ELEMENTAL STIFFNESS         ASSMBG  162
            C     CHECK FOR NON-ZERO BLOCK                                      ASSMBG  163
                  CALL UNPCK60 (KRECRD(NTK2),K,NTK1)                            ASSMBG  164
            131   FORMAT(1H0,*K=*,I3)                                           ASSMBG  165
165               IF (K.EQ.0) GO TO 200                                         ASSMBG  166
            C     CHECK FOR DIAGONAL BLOCK                                      ASSMBG  167
                  IF (J.EQ.1) GO TO 140                                         ASSMBG  168
                  GO TO 180                                                     ASSMBG  169
            C     CHECK DIAGONAL ELEMENTS (THIS BLOCK MAY NOT BE FULL)          ASSMBG  170
170           140 DO 150 K=1,NS                                                 ASSMBG  171
                  IF (A(K,K).EQ.0.) A(K,K)=1.                                   ASSMBG  172
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  150 CONTINUE                                                          ASSMBG  173
C     INCREASE DIAGONAL TERM FOR SPECIFIED DISPLACEMENTS                ASSMBG  174
C --- NOTE-- MULTIPLY BY BIGNO (NOT ADD) TO ALLOW RECOVERY OF TRUE      ASSMBG  175
C           STIFFNESS TERM IN CYCLO OR DDISP HANDLING LATER             ASSMBG  176
      LL=1                                                              ASSMBG  177
      DO 175 L=NR1,NR2                                                  ASSMBG  178
      IF (L.GT.NODES) GO TO 180                                         ASSMBG  179
      CALL UNPCK60 (KODEBC(L),KODEZ,1)                                  ASSMBG  180
      IF (KODEZ.EQ.0) GO TO 160                                         ASSMBG  181
      A(LL,LL)= A(LL,LL) * BIGNO                                        ASSMBG  182
  160 LL=LL+1                                                           ASSMBG  183
      CALL UNPCK60 (KODEBC(L),KODER,2)                                  ASSMBG  184
  165 FORMAT(1H0,*KODER= *,I3,* NODE= *,I3)                             ASSMBG  186
      IF (KODER.EQ.0) GO TO 170                                         ASSMBG  187
      A(LL,LL)= A(LL,LL) * BIGNO                                        ASSMBG  188
  170 LL=LL+1                                                           ASSMBG  189
      CALL UNPCK60(KODEBC(L),KODEM,3)                                   ASSMBG  190
      IF(KODEM.EQ.0)GO TO 175                                           ASSMBG  191
      A(LL,LL)=A(LL,LL)*BIGNO                                           ASSMBG  192
  175 LL=LL+1                                                           ASSMBG  193
  180 CALL WRITMS (LUK,A,NSIZE,NTK)                                     ASSMBG  194
  181 FORMAT(1H ,*NTK=*,I4)                                             ASSMBG  195
C     INITIALIZE BLOCK                                                  ASSMBG  196
      DO 190 K=1,NSIZE                                                  ASSMBG  197
  190 A(K)=0.                                                           ASSMBG  198
  200 JSHIFT=JSHIFT+NS                                                  ASSMBG  199
  210 NC1=NC2+1                                                         ASSMBG  200
C     CHECK IF ELEMENT K WILL CONTRIBUTE TO THIS ELEMENT BLOCK          ASSMBG  201
C      LOOP 280 REMOVED BECAUSE ELEMENTS DO NOT HAVE ELEMENT LOAD       ASSMBG  202
C    + VECTORS. D. HAWKINS.                                             ASSMBG  203
  280 CONTINUE                                                          ASSMBG  204
C     ADD APPLIED FORCES , SET UP SPECIFIED DISPLACEMENTS, FOR BLOCK    ASSMBG  205
      LL=1                                                              ASSMBG  206
      DO 321 L=NR1,NR2                                                  ASSMBG  207
      IF (L.GT.NODES) GO TO 330                                         ASSMBG  208
      CALL UNPCK60 (KODEBC(L),KODEZ,1)                                  ASSMBG  209
      IF (KODEZ.EQ.0) GO TO 290                                         ASSMBG  210
      GO TO 300                                                         ASSMBG  211
  290 B(LL)=B(LL)+FOZ(L)                                                ASSMBG  212
  300 LL=LL+1                                                           ASSMBG  213
      CALL UNPCK60 (KODEBC(L),KODER,2)                                  ASSMBG  214
      IF (KODER.EQ.0) GO TO 310                                         ASSMBG  215
      GO TO 320                                                         ASSMBG  216
  310 B(LL)=B(LL)+FOR(L)                                                ASSMBG  217
  320 LL=LL+1                                                           ASSMBG  218
      CALL UNPCK60(KODEBC(L),KODEM,3)                                   ASSMBG  219
      IF(KODEM.EQ.0)GO TO 311                                           ASSMBG  220
      GO TO 321                                                         ASSMBG  221
  311 B(LL)=B(LL)                                                       ASSMBG  222
  321 LL=LL+1                                                           ASSMBG  223
  330 CALL WRITMS (LUR,B,NS,1)                                          ASSMBG  224
      ISHIFT=ISHIFT+NS                                                  ASSMBG  225
  340 NR1=NR2+1                                                         ASSMBG  226
C                                                                       ASSMBG  227
C     CHECK FOR CYCLO OR DDISP                                          ASSMBG  228
C                                                                       ASSMBG  229
      NDEL1=NDEL+1                                                      ASSMBG  230
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      705 IF (NDDISP .EQ. 0) GO TO 890                                  ASSMBG   231
230   706 IWHICH= 1                                                     ASSMBG   232
          KOUNT= 0                                                      ASSMBG   233
      710 KOUNT= KOUNT + 1                                              ASSMBG   234
          IF (KOUNT .GT. NDDISP) GO TO 890                              ASSMBG   235
          IZEROS=0                                                      ASSMBG   236
235       N1= IABS(I1DDSP(KOUNT))                                       ASSMBG   237
          IF(N1.EQ.0)GO TO 870                                          ASSMBG   238
          N2= IABS(I2DDSP(KOUNT))                                       ASSMBG   239
          DDX= 0.                                                       ASSMBG   240
          KCYODD= 0                                                     ASSMBG   241
240       IF ( I1DDSP(KOUNT) .GT. 0) GO TO 715                          ASSMBG   242
          KCYODD= 1                                                     ASSMBG   243
          DDX= DDISPX(KOUNT)                                            ASSMBG   244
          IF (DDX .NE. 0.) IZEROS= 1                                    ASSMBG   245
      715 DDY= 0.                                                       ASSMBG   246
245       IF (I2DDSP(KOUNT) .GT. 0) GO TO 720                           ASSMBG   247
          KCYODD= KCYODD + 2                                            ASSMBG   248
          DDY= DDISPY(KOUNT)                                            ASSMBG   249
          IF (DDY .NE. 0.) IZEROS= 1                                    ASSMBG   250
C     NODAL PAIR (N1,N2).  N1 .LT. N2   N1 IS DEPENDENT AND ONE OR BOTH ASSMBG   251
250 C          (KCYODD=3) FREEDOMS WILL BE DROPPED FROM SYSTEM.         ASSMBG   252
      720 NR= (N1 - 1) / NDEL1 + 1                                      ASSMBG   253
          NC= NR                                                        ASSMBG   254
          ICOL= N1 * NDOF - (NR - 1) * NS                               ASSMBG   255
          ICOL=ICOL-1                                                   ASSMBG   256
255       ICOLM1= ICOL - 1                                              ASSMBG   257
          NR1= (N2 - 1) / NDEL1 + 1                                     ASSMBG   258
          ICOL1= N2 * NDOF - (NR1 -1) * NS                              ASSMBG   259
          ICOL1=ICOL1-1                                                 ASSMBG   260
          ICOL1M1= ICOL1 - 1                                            ASSMBG   261
260       JDEL= NR1 - NR                                                ASSMBG   262
C     CHECK FOR NON-ZERO DDISPS                                         ASSMBG   263
          IF ( IZEROS .EQ. 0) GO TO 970                                 ASSMBG   264
C     CALC. FORCES DUE TO NON-ZERO DDISPS                               ASSMBG   265
          DO 930 J=1,MM                                                 ASSMBG   266
265       NTK= NRCD(NR,J)                                               ASSMBG   267
          NTK1= MOD(NTK,60)                                             ASSMBG   268
          IF (NTK1 .EQ. 0) NTK1= 60                                     ASSMBG   269
          NTK2= (NTK - 1) / 60 + 1                                      ASSMBG   270
          CALL UNPCK60 (KRECRD(NTK2), L, NTK1 )                         ASSMBG   271
270       IF (L .EQ. 0) GO TO 920                                       ASSMBG   272
          CALL READMS (LUK, C, NSIZE, NTK )                             ASSMBG   273
C     REMOVE BIGNO ON DIAGONAL BLOCK                                    ASSMBG   274
          IF (J .GT. 1) GO TO 900                                       ASSMBG   275
          IF (KCYODD .NE. 2 ) C(ICOLM1,ICOLM1)= C(ICOLM1,ICOLM1) / BIGNO ASSMBG   276
275       IF (KCYODD .NE. 1 ) C(ICOL,ICOL)= C(ICOL,ICOL) / BIGNO        ASSMBG   277
C     PICK UP LOAD VECTOR, MODIFY, AND REWRITE                          ASSMBG   278
      900 CALL READMS (LUK, B, NS, NR )                                 ASSMBG   279
          DO 910 N=1,NS                                                 ASSMBG   280
                              B(N)= B(N) - C(N,ICOLM1) * DDX - C(N,ICOL) *DDY ASSMBG   281
280       910 CONTINUE                                                  ASSMBG   282
C     REWRITE BLOCK IN PLACE                                            ASSMBG   283
          CALL WRITMS (LUK, B, NS, NR, 1 )                              ASSMBG   284
      920 NR= NR - 1                                                    ASSMBG   285
          IF ( NR .EQ. 0) GO TO 935                                     ASSMBG   286
285       930 CONTINUE                                                  ASSMBG   287
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0 0 5 2 3

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                  935 NR= NC                                                                ASSMBG   288
                      IF (NC .EQ. NN) GO TO 970                                             ASSMBG   289
                      DO 950 J=2,MM                                                         ASSMBG   290
                      NTK= NRCD(NR,J)                                                       ASSMBG   291
290                   NTK1= MOD(NTK,60)                                                     ASSMBG   292
                      IF (NTK1 .EQ. 0) NTK1= 60                                             ASSMBG   293
                      NTK2= (NTK - 1) / 60 + 1                                              ASSMBG   294
                      CALL UNPCK60  (KRECRD(NTK2), L, NTK1)                                 ASSMBG   295
                      NC= NC + 1                                                            ASSMBG   296
295                   IF (L .EQ. 0) GO TO 940                                               ASSMBG   297
                      CALL READMS (LUK, C, NSIZE, NTK )                                     ASSMBG   298
                C     PICK UP LOAD VECTOR, MODIFY, REWRITE                                  ASSMBG   299
                      CALL READMS (LUR, B, NS, NC )                                         ASSMBG   300
                      DO 937 N=1,NS                                                         ASSMBG   301
300                                   B(N)= B(N) - C(ICOLM1,N)*DDX -C(ICOL,N)*DDY           ASSMBG   302
                  937 CONTINUE                                                              ASSMBG   303
                      CALL WRITMS ( LUR, B, NS, NC, 1 )                                     ASSMBG   304
                  940 IF ( NC .EQ. NN) GO TO 960                                            ASSMBG   305
                  950 CONTINUE                                                              ASSMBG   306
305               960 NC= NR                                                                ASSMBG   307
                  970 CONTINUE                                                              ASSMBG   308
                C     ADD ROWS AND COLUMNS FOR N1 TO THOSE FOR N2  (** ONLY FOR NUOF=2)     ASSMBG   309
                C     FIRST, COLUMN OF BLOCKS, STARTING AT DIAGONAL BLOCK                   ASSMBG   310
                      DO 760 J=1,MM                                                         ASSMBG   311
310             C     PICK UP DEPENDENT BLOCK                                               ASSMBG   312
                      NTK= NRCD(NP,J)                                                       ASSMBG   313
                      NTK1= MOD(NTK,60)                                                     ASSMBG   314
                      IF (NTK1 .EQ. 0) NTK1= 60                                             ASSMBG   315
                      NTK2= (NTK - 1) / 60 + 1                                              ASSMBG   316
315                   CALL UNPCK60 (KRECRD(NTK2), L, NTK1 )                                 ASSMBG   317
                      IF (L .EQ. 0) GO TO 755                                               ASSMBG   318
                      CALL READMS (LUK, C, NSIZE, NTK )                                     ASSMBG   319
                C     REMOVE BIGNO ON DIAGONAL BLOCK                                        ASSMBG   320
                      IF (J .GT. 1) GO TO 735                                               ASSMBG   321
320                   IF (KCYODD .NE. 2 ) C(ICOLM1,ICOLM1)= C(ICOLM1,ICOLM1) / BIGNO        ASSMBG   322
                      IF (KCYODD .NE. 1 ) C(ICOL,ICOL)= C(ICOL,ICOL) / BIGNO                ASSMBG   323
                C     PICK UP INDEPENDENT BLOCK                                             ASSMBG   324
                  735 JJ= J + JDEL                                                          ASSMBG   325
                      NTKI= NRCD(NR,JJ)                                                     ASSMBG   326
325                   NTKI1= MOD(NTKI,60)                                                   ASSMBG   327
                      IF (NTKI1 .EQ. 0) NTKI1= 60                                           ASSMBG   328
                      NTKI2= (NTKI - 1) / 60 + 1                                            ASSMBG   329
                      CALL UNPCK60 ( KRECRD(NTKI2), L, NTKI1 )                              ASSMBG   330
                      IF (L .EQ. 0) GO TO 740                                               ASSMBG   331
330                   CALL READMS (LUK, A, NSIZE, NTKI )                                    ASSMBG   332
                      IBEFOR= 1                                                             ASSMBG   333
                      GO TO 745                                                             ASSMBG   334
                  740 CALL MEMSET ( A, A(NSIZE), 0. )                                       ASSMBG   335
                      IBEFOR= 0                                                             ASSMBG   336
335                   CALL PACK60 ( KRECRD(NTKI2), 1, NTKI1 )                               ASSMBG   337
                  745 IF (J .GT. 1) GO TO 748                                               ASSMBG   338
                      IF (JDEL .NE. 0) GO TO 747                                            ASSMBG   339
                C     BOTH NODES ARE IN THE SAME BLOCK, ALSO ADD ROWS                       ASSMBG   340
                      DO 746 N=1,NS                                                         ASSMBG   341
340                   IF (KCYODD .NE. 2) A(ICOLIM1,N)= A(ICOLIM1,N) + C(ICOLM1,N)           ASSMBG   342
                      IF (KCYODD .NE. 1) A(ICOLI,N)= A(ICOLI,N) + C(ICOL,N)                 ASSMBG   343
                C     MAKE SAME CHANGES TO C BEFORE COLS ARE ADDED                          ASSMBG   344
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                C(ICOLIM1,N)= A(ICOLIM1,N)                                        ASSMBG   345
                C(ICOLI  ,N)= A(ICOLI  ,N)                                        ASSMBG   346
345           746 CONTINUE                                                        ASSMBG   347
                GO TO 748                                                         ASSMBG   348
              C     SAVE TERMS TO BE ADDED TO DIAGONAL AREA LATER                 ASSMBG   349
              747 SAV11= A(ICOLM1,ICOLIM1)                                        ASSMBG   350
                SAV12= A(ICOLM1,ICOLI)                                            ASSMBG   351
350             SAV21= A(ICOL,ICOLIM1)                                            ASSMBG   352
                SAV22= A(ICOL,ICOLI)                                              ASSMBG   353
              C     ADD COLS.                                                     ASSMBG   354
              748 DO 750 N=1,NS                                                   ASSMBG   355
                IF (KCYODD .NE. 2) A(N,ICOLIM1)= A(N,ICOLIM1) + C(N,ICOLM1)       ASSMBG   356
355             IF (KCYODD .NE. 1) A(N,ICOLI)= A(N,ICOLI) + C(N,ICOL)             ASSMBG   357
              750 CONTINUE                                                        ASSMBG   358
              C     REWRITE BLOCK IN PLACE IF WRITTEN BEFORE)                     ASSMBG   359
                CALL WRITMS (LUK, A, NSIZE, NTKI , IBEFOR )                       ASSMBG   360
              C     PREPARE FOR NEXT BLOCK                                        ASSMBG   361
360           755 NR= NR - 1                                                      ASSMBG   362
                IF (NR .EQ. 0) GO TO 765                                          ASSMBG   363
              760 CONTINUE                                                        ASSMBG   364
              C     LAST, ROW OF BLOCKS, STARTING PAST THE DIAGONAL BLOCK         ASSMBG   365
              765 IF (NC .EQ. NN) GO TO 865                                       ASSMBG   366
365             NR= NC                                                            ASSMBG   367
                JJ= JDEL + 1                                                      ASSMBG   368
                DO 860 J=2,MM                                                     ASSMBG   369
              C     PICK UP DEPENDENT BLOCK                                       ASSMBG   370
                NTK= NRCD(NR,J)                                                   ASSMBG   371
370             NTK1= MOD(NTK,60)                                                 ASSMBG   372
                IF (NTK1 .EQ. 0) NTK1= 60                                         ASSMBG   373
                NTK2= (NTK - 1) / 60 + 1                                          ASSMBG   374
                CALL UNPCK60  (KRECRD(NTK2), L, NTK1)                             ASSMBG   375
                NC= NC + 1                                                        ASSMBG   376
375             IF ( J - 1 - JDEL ) 770,775,780                                   ASSMBG   377
              770 JJ= JJ - 1                                                      ASSMBG   378
                NRR= NC                                                           ASSMBG   379
                GO TO 785                                                         ASSMBG   380
              775 JJ= 1                                                           ASSMBG   381
380             NRR= NRI                                                          ASSMBG   382
                GO TO 785                                                         ASSMBG   383
              780 JJ= JJ + 1                                                      ASSMBG   384
                NRR= NRI                                                          ASSMBG   385
              785 CONTINUE                                                        ASSMBG   386
385             IF (L .EQ. 0) GO TO 855                                           ASSMBG   387
                CALL READMS (LUK, C, NSIZE, NTK )                                 ASSMBG   388
              C     PICK UP INDEPENDENT BLOCK                                     ASSMBG   389
                NTK1= NRCD (NRR,JJ)                                               ASSMBG   390
                NTK11= MOD (NTK1,60)                                              ASSMBG   391
390             IF (NTK11.EQ. 0) NTK11= 60                                        ASSMBG   392
                NTK12= (NTK1 - 1) / 60 + 1                                        ASSMBG   393
                CALL UNPCK60 (KRECRD(NTK12), L, NTK11)                            ASSMBG   394
                IF (L .EQ. 0) GO TO 815                                           ASSMBG   395
                CALL READMS (LUK, A, NSIZE, NTK1 )                                ASSMBG   396
395             IBEFOR= 1                                                         ASSMBG   397
                GO TO 820                                                         ASSMBG   398
              815 CALL MEMSET (A, A(NSIZE), 0. )                                  ASSMBG   399
                IBEFOR= 0                                                         ASSMBG   400
                CALL PACK60 ( KRECRD(NTK12), 1, NTK11 )                           ASSMBG   401
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0 0 0 5 3 2 3

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      820 DO 830 N=1,NS                                                  ASSMBG  402
          IF (NRR .EQ. NRI) GO TO 825                                    ASSMBG  403
C         ADD ROW (COLUMN TRANSPOSE) TO COLUMN                           ASSMBG  404
          IF (KCYODD.NE.2) A(N,ICOLIM1)= A(N,ICOLIM1) + C(ICOLM1,N)      ASSMBG  405
          IF (KCYODD.NE.1) A(N,ICOLI)= A(N,ICOLI) + C(ICOL,N)            ASSMBG  406
          GO TO 830                                                      ASSMBG  407
C         ADD ROWS                                                       ASSMBG  408
      825 IF (KCYODD.NE.2) A(ICOLIM1,N)= A(ICOLIM1,N) + C(ICOLM1,N)      ASSMBG  409
          IF (KCYODD.NE.1) A(ICOLI,N)= A(ICOLI,N) + C(ICOL,N)            ASSMBG  410
      830 CONTINUE                                                       ASSMBG  411
C         CHECK FOR INDEPENDENT DIAGONAL BLOCK                           ASSMBG  412
          IF (JJ .GT. 1) GO TO 850                                       ASSMBG  413
C         ADD SAVED TERMS                                                ASSMBG  414
          IF (KCYODD .EQ. 1) GO TO 835                                   ASSMBG  415
          A(ICOLI,ICOLI)= A(ICOLI,ICOLI) + SAV22                         ASSMBG  416
          A(ICOLIM1,ICOLI)= A(ICOLIM1,ICOLI) + SAV21                     ASSMBG  417
      835 IF (KCYODD .EQ. 2) GO TO 840                                   ASSMBG  418
          A(ICOLIM1,ICOLIM1)= A(ICOLIM1,ICOLIM1) + SAV11                 ASSMBG  419
          A(ICOLI,ICOLIM1)= A(ICOLI,ICOLIM1) + SAV12                     ASSMBG  420
C         SYMMETRY OF DIAGONAL BLOCK MUST BE RESTORED                    ASSMBG  421
      840 DO 845 N=1,NS                                                  ASSMBG  422
          IF (N .EQ. ICOLI .OR. N .EQ. ICOLIM1) GO TO 845                ASSMBG  423
          A(N,ICOLIM1)= A(ICOLIM1,N)                                     ASSMBG  424
          A(N,ICOLI)= A(ICOLI,N)                                         ASSMBG  425
      845 CONTINUE                                                       ASSMBG  426
C         REWRITE BLOCK IN PLACE IF WRITTEN BEFORE                       ASSMBG  427
      850 CALL WRITMS (LUK, A, NSIZE, NTKI, IBEFOR )                     ASSMBG  428
C         PREPARE FOR NEXT BLOCK                                         ASSMBG  429
      855 IF (NC .EQ. NN) GO TO 865                                      ASSMBG  430
      860 CONTINUE                                                       ASSMBG  431
C         ADD ROWS OF LOAD VECTORS                                       ASSMBG  432
      865 CALL READMS (LUR, B, NS, NR )                                  ASSMBG  433
          CALL READMS (LUR, C, NS, NRI )                                 ASSMBG  434
          IF (KCYODD .NE. 2) C(ICOLIM1)= C(ICOLIM1) + B(ICOLM1)          ASSMBG  435
          IF (KCYODD .NE. 1) C(ICOLI)= C(ICOLI) + B(ICOL)                ASSMBG  436
          CALL WRITMS (LUR, C, NS, NRI, 1 )                              ASSMBG  437
C         MODIFICATIONS COMPLETE FOR THIS DDISP OR CYCLO PAIR            ASSMBG  438
      870 CONTINUE                                                       ASSMBG  439
          GO TO 710                                                      ASSMBG  440
C         ALL MODS COMPLETED FOR DDISP, CYCLO                            ASSMBG  441
      890 CONTINUE                                                       ASSMBG  442
C         NON-ZERO SPECIFIED DISPLACEMENTS                               ASSMBG  443
          NDEL1=NDEL+1                                                   ASSMBG  444
          DO 480 I=1,NODES                                               ASSMBG  445
          M=0                                                            ASSMBG  446
          U(1)=0.                                                        ASSMBG  447
          IF (FDZ(I).EQ.0.) GO TO 350                                    ASSMBG  448
          CALL UNPCK60 (KODEHC(I),KODEZ,1)                               ASSMBG  449
          IF (KODEZ.EQ.0) GO TO 350                                      ASSMBG  450
          U(1)=FDZ(I)                                                    ASSMBG  451
          M=1                                                            ASSMBG  452
      350 IF (FDR(I).EQ.0.) GO TO 360                                    ASSMBG  453
          CALL UNPCK60 (KODEHC(I),KODER,2)                               ASSMBG  454
          IF (KODER.EQ.0) GO TO 360                                      ASSMBG  455
          U(2)=FDR(I)                                                    ASSMBG  456
          M=2                                                            ASSMBG  457
      360 IF (M.EQ.0) GO TO 480                                          ASSMBG  458
```



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```
      C     U ARRAY CONTAINS M VALUES OF SPECIFIED DEFLECTIONS -- DUMMY VALUES  ASSMBG  459
      C           PRESENT (IF ANY)  ARE SET TO ZERO                            ASSMBG  460
      C     SET ROW BLOCK NO.                                                    ASSMBG  461
      C                                                                          ASSMBG  462
  460       NR=(I-1)/NDOF+1                                                      ASSMBG  463
      C     NC1= FIRST COLUMN OF UPPER BLOCKS TO BE ACCESSED                     ASSMBG  464
            NC1=(I-1)*NDOF-(NR-1)*NS+1                                         ASSMBG  465
            NC2=NC1+M-1                                                        ASSMBG  466
            NC=NR                                                              ASSMBG  467
  465       DO 420 J=1,MM                                                        ASSMBG  468
      C     BLOCK NO. IN STIFFNESS MATRIX                                        ASSMBG  469
            NTK=NRCD(NC,J)                                                     ASSMBG  470
            NTK1=MOD(NTK,60)                                                   ASSMBG  471
            IF (NTK1.EQ.0) NTK1=60                                             ASSMBG  472
  470       NTK2=(NTK-1)/60+1                                                    ASSMBG  473
      C     TEST FOR ZERO BLOCK                                                  ASSMBG  474
            CALL UNPCK60 (KRECRD(NTK2),L,NTK1)                                 ASSMBG  475
            IF (L.EQ.0) GO TO 410                                              ASSMBG  476
            CALL READMS (LUR,B,NS,NC)                                          ASSMBG  477
  475       CALL READMS (LUK,A,NSIZE,NTK)                                        ASSMBG  478
            DO 380 N=1,NS                                                      ASSMBG  479
            LL=1                                                               ASSMBG  480
            DO 370 K=NC1,NC2                                                   ASSMBG  481
            B(N)=B(N)-A(N,K)*U(LL)                                             ASSMBG  482
  480     370 LL=LL+1                                                          ASSMBG  483
          380 CONTINUE                                                         ASSMBG  484
      C     CHECK FOR DIAG. BLOCK                                              ASSMBG  485
            IF (J.NE.1) GO TO 400                                              ASSMBG  486
            LL=1                                                               ASSMBG  487
  485       DO 390 K=NC1,NC2                                                     ASSMBG  488
            IF (U(LL).EQ.0.) GO TO 390                                         ASSMBG  489
            B(K)=U(LL)                                                         ASSMBG  490
          390 LL=LL+1                                                          ASSMBG  491
      C     REWRITE VECTORS                                                    ASSMBG  492
  490     400 CALL WRITMS (LUR,B,NS,NC)                                        ASSMBG  493
      C     PREPARE FOR NEXT UPPER BLOCK                                       ASSMBG  494
          410 NC=NC-1                                                          ASSMBG  495
            IF (NC.EQ.0) GO TO 430                                             ASSMBG  496
          420 CONTINUE                                                         ASSMBG  497
  495 C     NOW LOWER BLOCKS (TRANSPOSE OF UPPER BLOCKS )                      ASSMBG  498
          430 IF (NR.EQ.NN) GO TO 480                                          ASSMBG  499
            NC=NR+1                                                            ASSMBG  500
            DO 470 J=2,MM                                                      ASSMBG  501
      C     BLOCK NO.                                                          ASSMBG  502
  500       NTK=NRCD(NR,J)                                                       ASSMBG  503
            NTK1=MOD(NTK,60)                                                   ASSMBG  504
            IF (NTK1.EQ.0) NTK1=60                                             ASSMBG  505
            NTK2=(NTK-1)/60+1                                                  ASSMBG  506
      C     CHECK FOR ZERO BLOCK                                               ASSMBG  507
            CALL UNPCK60 (KRECRD(NTK2),L,NTK1)                                 ASSMBG  508
  505       IF (L.EQ.0) GO TO 460                                              ASSMBG  509
            CALL READMS (LUR,B,NS,NC)                                          ASSMBG  510
            CALL READMS (LUK,A,NSIZE,NTK)                                      ASSMBG  511
            DO 450 N=1,NS                                                      ASSMBG  512
  510       LL=1                                                               ASSMBG  513
            DO 440 K=NC1,NC2                                                   ASSMBG  514
            B(N)=B(N)-A(K,N)*U(LL)                                             ASSMBG  515
          440 LL=LL+1
```



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```
                  450 CONTINUE                                                    ASSMBG   516
515               C     REWRITE                                                   ASSMBG   517
                        CALL WRITMS (LUR,B,NS,NC)                                 ASSMBG   518
                  C     PREPARE FOR NEXT BLOCK                                    ASSMBG   519
                  460   NC=NC+1                                                   ASSMBG   520
                        IF (NC.GT.NN) GO TO 480                                   ASSMBG   521
520               470   CONTINUE                                                  ASSMBG   522
                  480   CONTINUE                                                  ASSMBG   523
                  C --- NOTE -- SPECIFIED DEFLECTIONS MUST BE RESET INTO SOLUTION VECTOR ASSMBG 524
                  C                 AFTER SOLUTION BY SYMSOL                      ASSMBG   525
                  C                                                               ASSMBG   526
525               C     END                                                       ASSMBG   527
```

| CARD NR. | SEVERITY | DETAILS | DIAGNOSIS OF PROBLEM |
|---|---|---|---|
| 282 | I | ) | ARGUMENT COUNT INCONSISTENT WITH PRIOR USAGE. |
| 302 | I | ) | ARGUMENT COUNT INCONSISTENT WITH PRIOR USAGE. |
| 358 | I | ) | ARGUMENT COUNT INCONSISTENT WITH PRIOR USAGE. |
| 426 | I | ) | ARGUMENT COUNT INCONSISTENT WITH PRIOR USAGE. |
| 435 | I | ) | ARGUMENT COUNT INCONSISTENT WITH PRIOR USAGE. |



0 0 5 2 3

```
      OVERLAY(ISOFR1,6,2)                                                    SYMSOL     2
      PROGRAM SYMSOL                                                         SYMSOL     3
C                                                                            SYMSOL     4
C     NN  = NO. OF BLOCKS ON DIAGONAL (FCT. OF NO. OF EQUATIONS)             SYMSOL     5
C     MM  = NO. OF BLOCKS PER ROW (FCT. OF BAND)                             SYMSOL     6
C     NS  = ORDER OF MATRIX BLOCKS                                           SYMSOL     7
C     NCOUNT= NS * NS                                                        SYMSOL     8
C     LUK= UNIT WHERE STIFFNESS BLOCKS ARE STORED                            SYMSOL     9
C     LUR= UNIT WHERE LOAD VECTOR BLOCKS ARE STORED                          SYMSOL    10
C     LUT= UNIT FOR SCRATCH USAGE (NN BLOCKS)                                SYMSOL    11
C     KRECRD CONTAINS FLAGS FOR ZERO BLOCKS                                  SYMSOL    12
C                                                                            SYMSOL    13
C     VARIABLES MUST BE DIMENSIONED --                                       SYMSOL    14
C        AK1(NSIZ), AK2(NSIZ), AK3(NSIZ), RB1(NS), RB2(NS), RB3(NS)          SYMSOL    15
C        KRECRD(MAX NO OF BLOCKS)                                            SYMSOL    16
C                                                                            SYMSOL    17
      COMMON/SYMSL1/AK1(144)                                                 SYMSOL    18
      COMMON/SYMSL2/AK2(144)                                                 SYMSOL    19
      COMMON/SYMSL3/AK3(144)                                                 SYMSOL    20
      COMMON/SYMSL4/RB1(12)                                                  SYMSOL    21
      COMMON/SYMSL5/RB2(12)                                                  SYMSOL    22
      COMMON/SYMSL6/RB3(12)                                                  SYMSOL    23
      COMMON/PSOL/NN,MM,NNPE,NDOF,NVECT,LUK,LUR,INDEX17(821),INDEX19(41)     SYMSOL    24
     *,KRECRD(820),NEQ                                                       SYMSOL    25
      COMMON / NSX / NS                                                      SYMSOL    26
      COMMON/SYMSOL/DUD(5),LUT,LUX,LUE,LURX,INDEX3(41)                       SYMSOL    27
C                                                                            SYMSOL    28
      NRCD(I,J)= ( (I+J) * (I+J-1) ) / 2 -J +1                               SYMSOL    29
C                                                                            SYMSOL    30
      NNMMP1= NN - MM + 1                                                    SYMSOL    31
      NCOUNT= NS * NS                                                        SYMSOL    32
      LENB= NS * NVECT                                                       SYMSOL    33
      KMM= MM                                                                SYMSOL    34
C     BEGIN FORWARD REDUCTION                                                SYMSOL    35
      N= 0                                                                   SYMSOL    36
  100 N= N + 1                                                               SYMSOL    37
C                                                                            SYMSOL    38
C     REDUCE MATRIX ROW N                                                    SYMSOL    39
C                                                                            SYMSOL    40
C     PICK UP DIAGONAL MATRIX BLOCK AND INVERT                               SYMSOL    41
      NTK= NRCD(N,1)                                                         SYMSOL    42
   10 FORMAT(1H ,*NTK=*,I4)                                                  SYMSOL    44
      CALL READMS (LUK, AK2, NCOUNT, NTK)                                    SYMSOL    45
      CALL INVERTS                                                           SYMSOL    46
C     PICK UP VECTOR BLOCK CORRES. TO ROW N                                  SYMSOL    47
      CALL READMS (LUR, RB1, LENB, N)                                        SYMSOL    48
      CALL MULT (RB1, RB2, NVECT)                                            SYMSOL    49
      CALL WRITMS (LUR, RB2, LENB, N)                                        SYMSOL    50
C                                                                            SYMSOL    51
C     CHECK FOR LAST ROW OF MATRICES                                         SYMSOL    52
C                                                                            SYMSOL    53
      IF (N .EQ. NN) GO TO 300                                               SYMSOL    54
C                                                                            SYMSOL    55
C     REDUCE BLOCKS IN ROW N                                                 SYMSOL    56
C                                                                            SYMSOL    57
      IF (N .GT. NNMMP1) KMM= KMM - 1                                        SYMSOL    58
      DO 200 K= 2, KMM                                                       SYMSOL    59
```

```
                C     PICK UP OFF-DIAGONAL BLOCK                                                SYMSOL     60
                      NTK= NRCD (N,K)                                                           SYMSOL     61
60              C     CHECK IF ZERO BLOCK                                                       SYMSOL     62
                      NTK1= MOD( NTK, 60 )                                                      SYMSOL     63
                      IF ( NTK1 .EQ. 0) NTK1= 60                                                SYMSOL     64
                      NTK2=  ( NTK - 1 ) / 60 + 1                                               SYMSOL     65
                      CALL UNPCK60 ( KRECRD(NTK2), I  , NTK1 )                                  SYMSOL     66
65                    IF (I   .EQ. 0 ) GO TO 200                                                SYMSOL     67
                      CALL READMS (LUK, AK1,NCOUNT, NTK)                                        SYMSOL     68
                      CALL MULT     ( AK1, AK3, NS )                                            SYMSOL     69
                      CALL WRITMS (LUK, AK3, NCOUNT, NTK )                                      SYMSOL     70
                C     TRANSPOSE BLOCK AND SAVE ON SCRATCH FILE FOR REDUCING REST OF ROWS        SYMSOL     71
                      IL= 0                                                                     SYMSOL     72
70                    DO 160 I=1,NS                                                             SYMSOL     73
                      IR= I                                                                     SYMSOL     74
                      DO 150 J=1,NS                                                             SYMSOL     75
                      IL= IL + 1                                                                SYMSOL     76
75                    AK3(IL)= AK1(IR)                                                          SYMSOL     77
                  150 IR= IR + NS                                                               SYMSOL     78
                  160  CONTINUE                                                                SYMSOL     79
                      CALL WRITMS (LUT, AK3, NCOUNT, K )                                        SYMSOL     80
                  200 CONTINUE                                                                  SYMSOL     81
80              C                                                                               SYMSOL     82
                C     REDUCE REST OF ROWS                                                       SYMSOL     83
                C                                                                               SYMSOL     84
                      DO 260 L=2,KMM                                                            SYMSOL     85
                      I= N + L - 1                                                              SYMSOL     86
                      IF (I .GT. NM) GO TO 100                                                  SYMSOL     87
85              C     PICK UP REDUCING BLOCK FROM SCRATCH                                       SYMSOL     88
                C     CHECK IF ZERO BLOCK                                                       SYMSOL     89
                      NTK= NRCD(N,L)                                                            SYMSOL     90
                      NTK1= MOD( NTK, 60 )                                                      SYMSOL     91
90                    IF ( NTK1 .EQ. 0) NTK1= 60                                                SYMSOL     92
                      NTK2=  ( NTK - 1 ) / 60 + 1                                               SYMSOL     93
                      CALL UNPCK60 ( KRECRD(NTK2), J  , NTK1 )                                  SYMSOL     94
                      IF (J   .EQ. 0 ) GO TO 260                                                SYMSOL     95
                      CALL READMS (LUT, AK2, NCOUNT, L )                                        SYMSOL     96
95                    J= 0                                                                      SYMSOL     97
                      DO 250 K=L,KMM                                                            SYMSOL     98
                      J= J + 1                                                                  SYMSOL     99
                      NTK= NRCD (N,K)                                                           SYMSOL    100
                C     CHECK IF ZERO BLOCK                                                       SYMSOL    101
100                   NTK1= MOD( NTK, 60 )                                                      SYMSOL    102
                      IF ( NTK1 .EQ. 0) NTK1= 60                                                SYMSOL    103
                      NTK2=  ( NTK - 1 ) / 60 + 1                                               SYMSOL    104
                      CALL UNPCK60 ( KRECRD(NTK2), I1 , NTK1 )                                  SYMSOL    105
                      IF (I1  .EQ. 0 ) GO TO 250                                                SYMSOL    106
105                   CALL READMS (LUK, AK1, NCOUNT, NTK )                                      SYMSOL    107
                      CALL MULT     ( AK1, AK3, NS )                                            SYMSOL    108
                      NTK= NRCD(I,J)                                                            SYMSOL    109
                C     CHECK IF ZERO BLOCK                                                       SYMSOL    110
                      NTK1= MOD( NTK, 60 )                                                      SYMSOL    111
110                   IF ( NTK1 .EQ. 0) NTK1= 60                                                SYMSOL    112
                      NTK2=  ( NTK - 1 ) / 60 + 1                                               SYMSOL    113
                      CALL UNPCK60 ( KRECRD(NTK2), I1 , NTK1 )                                  SYMSOL    114
                      IF (I1  .EQ. 0 ) GO TO 220                                                SYMSOL    115
                      CALL READMS (LUK, AK1, NCOUNT, NTK )                                      SYMSOL    116
```



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115                DO 210 I1=1,NCOUNT                                    SYMSOL  117
                 210 AK1(I1)= AK1(I1) - AK3(I1)                          SYMSOL  118
                     GO TO 240                                           SYMSOL  119
                 220 DO 230 I1= 1,NCOUNT                                 SYMSOL  120
                 230 AK1(I1)= - AK3(I1)                                  SYMSOL  121
120              C   SET FLAG FOR NON-ZERO BLOCK                         SYMSOL  122
                     CALL PACK60 ( KRECRD(NTK2), 1 , NTK1 )              SYMSOL  123
                 240 CALL WRITMS (LUK, AK1, NCOUNT, NTK )                SYMSOL  124
                 250 CONTINUE                                            SYMSOL  125
                     CALL MULT (RR2, RB3, NVECT)                         SYMSOL  126
125              C   REDUCE CORRES. VECTOR BLOCK ROW                     SYMSOL  127
                     CALL READMS (LUR, RB1, LENB, I)                     SYMSOL  128
                     DO 255 I1= 1, LENB                                  SYMSOL  129
                 255 RB1(I1)= RB1(I1) - RB3(I1)                          SYMSOL  130
                     CALL WRITMS (LUR, RB1, LENB, I)                     SYMSOL  131
130              260 CONTINUE                                            SYMSOL  132
                     GO TO 100                                           SYMSOL  133
                 C                                                       SYMSOL  134
                 C   BACK SUBSTITUTION                                   SYMSOL  135
                 C                                                       SYMSOL  136
135              300 N= N - 1                                            SYMSOL  137
                 C                                                       SYMSOL  138
                 C   CHECK FOR FIRST ROW OF BLOCKS                       SYMSOL  139
                 C                                                       SYMSOL  140
                     IF (N .EQ. 0) GO TO 500                             SYMSOL  141
140              C                                                       SYMSOL  142
                 C   CALCULATE ANSWERS FOR THIS ROW                      SYMSOL  143
                 C                                                       SYMSOL  144
                     CALL READMS (LUR, RB3, LENB, N)                     SYMSOL  145
                     DO 400 K=2,KMM                                      SYMSOL  146
145                  L= N + K - 1                                        SYMSOL  147
                     IF (L .GT. NM) GO TO 450                            SYMSOL  148
                     NTK= NRCD(N,K)                                      SYMSOL  149
                 C   CHECK IF ZERO BLOCK                                 SYMSOL  150
                     NTK1= MOD( NTK, 60 )                                SYMSOL  151
150                  IF ( NTK1 .EQ. 0) NTK1= 60                          SYMSOL  152
                     NTK2=  ( NTK - 1 ) / 60 + 1                         SYMSOL  153
                     CALL UNPCK60 ( KRECRD(NTK2), K1 , NTK1 )            SYMSOL  154
                     IF (K1  .EQ. 0 ) GO TO 400                          SYMSOL  155
                     CALL READMS (LUK, AK2, NCOUNT, NTK )                SYMSOL  156
155                  CALL READMS (LUR, RB1, LENB, L)                     SYMSOL  157
                     CALL MULT (RB1, RB2, NVECT)                         SYMSOL  158
                     DO 310 K1= 1,LENB                                   SYMSOL  159
                 310 RB3(K1)= RB3(K1) - RB2(K1)                          SYMSOL  160
                 400 CONTINUE                                            SYMSOL  161
160              450 CALL WRITMS ( LUR, RB3, LENB, N )                   SYMSOL  162
                     KMM= KMM + 1                                        SYMSOL  163
                     IF (KMM .GT. MM) KMM= MM                            SYMSOL  164
                     GO TO 300                                           SYMSOL  165
                 500 CONTINUE                                            SYMSOL  166
165                  END                                                 SYMSOL  167
```

```
      SUBROUTINE MULT   (B,C,NC)                                        MULT    2
      DIMENSION A(1), B(1), C(1)                                        MULT    3
      COMMON / SYMSL2 / A                                               MULT    4
      COMMON / SYMSOL / NN, MM                                          MULT    5
      COMMON / NSX / NR                                                 MULT    6
C                                                                       MULT    7
C     MULTIPLY A(NR,NR) * B(NR,NC) AND STORE IN C(NR,NC)                MULT    8
C                                                                       MULT    9
      DO 300 I=1,NR                                                     MULT   10
      IC= 1                                                             MULT   11
      JJ= 0                                                             MULT   12
      DO 200 J=1,NC                                                     MULT   13
      SUM= 0.                                                           MULT   14
      IA= 1                                                             MULT   15
      IB= JJ                                                            MULT   16
      DO 100 K=1,NR                                                     MULT   17
      IB= IB + 1                                                        MULT   18
      SUM= SUM + A(IA) * B(IB)                                          MULT   19
  100 IA= IA + NR                                                       MULT   20
      C(IC)= SUM                                                        MULT   21
      IC= IC + NR                                                       MULT   22
      JJ= JJ + NR                                                       MULT   23
  200 CONTINUE                                                          MULT   24
  300 CONTINUE                                                          MULT   25
      RETURN                                                            MULT   26
      END                                                               MULT   27
```

```
      SUBROUTINE INVERTS                                                INVERT     2
C                                                                       INVERT     3
C     INVERT SYMMETRIC MATRIX S(NM,NM)                                  INVERT     4
C     ONLY THE UPPER HALF OF S MUST BE SUPPLIED                         INVERT     5
C     THE FULL INVERSE IS RETURNED                                      INVERT     6
C                                                                       INVERT     7
      COMMON / SYMSL2 / S(1)                                            INVERT     8
      COMMON/PSOL/NN,MM                                                 INVERT     9
      COMMON / NSX / M                                                  INVERT    10
C     M IS THE MATRIX SIZE                                              INVERT    11
   10 DO 110 J=1,M                                                      INVERT    12
      IJ=J-1                                                            INVERT    13
      IJM= IJ * M                                                       INVERT    14
C     SWEEP OUT ALL ROWS EXCEPT PIVOTAL ROW J                           INVERT    15
      XPIV=S(IJM + J )                                                  INVERT    16
      IF (XPIV .EQ. 0. ) GO TO 500                                      INVERT    17
      DO 90 I=1,M                                                       INVERT    18
      IF (J-I) 40,90,20                                                 INVERT    19
   20 JJ= IJM + I                                                       INVERT    20
      IF (S(JJ) .EQ. 0.) GO TO 90                                       INVERT    21
      JC=J                                                              INVERT    22
      AX=S( JJ)/XPIV                                                    INVERT    23
      II= 0                                                             INVERT    24
      DO 30 K=1,I                                                       INVERT    25
      S(II+I)= S(II+I) - AX * S(II+J)                                   INVERT    26
   30 II= II + M                                                        INVERT    27
      GO TO 70                                                          INVERT    28
   40 JC=I                                                              INVERT    29
      AX=S( (I-1)*M + J ) / XPIV                                        INVERT    30
      IF (AX .EQ. 0. ) GO TO 85                                         INVERT    31
      IF (IJ) 70,70,50                                                  INVERT    32
   50 II= 0                                                             INVERT    33
      DO 60 K=1,IJ                                                      INVERT    34
      S(II+I)= S(II+I) - AX * S(II+J)                                   INVERT    35
   60 II= II + M                                                        INVERT    36
   70 DO 80 K=JC,M                                                      INVERT    37
      II= (K - 1 ) * M                                                  INVERT    38
   80 S(II+I)= S(II+I) - AX * S(II+J)                                   INVERT    39
   85 S(IJM+I)= -AX                                                     INVERT    40
   90 CONTINUE                                                          INVERT    41
C                                                                       INVERT    42
C     SWEEP OUT PIVOTAL ROW J                                           INVERT    43
C                                                                       INVERT    44
      II= 0                                                             INVERT    45
      DO 100 K=1,M                                                      INVERT    46
      S(II+J)= S(II+J) / XPIV                                           INVERT    47
  100 II= II + M                                                        INVERT    48
      S(IJM + J )= S(IJM + J ) / XPIV                                   INVERT    49
  110 CONTINUE                                                          INVERT    50
      II= 0                                                             INVERT    51
      DO 130 I=1,M                                                      INVERT    52
      DO 120 J=1,M                                                      INVERT    53
  120 S( (J-1)*M + I ) = S(II+J)                                        INVERT    54
  130 II= II + M                                                        INVERT    55
      RETURN                                                            INVERT    56
C                                                                       INVERT    57
  500 IJ= IJ + 1                                                        INVERT    58
```

181
157
6 2 5 0 0

```
      PRINT 1000, IJ                                                    INVERT     59
      STOP                                                              INVERT     60
60    1000 FORMAT (23H0INVERT FAILURE AT ROW     I5)                    INVERT     61
      END                                                               INVERT     62
```



6 2 5 0 0

```
      OVERLAY(ISOFR1,6,3)                                                    RECOVR     2
      PROGRAM RECOVR                                                         RECOVR     3
C                                                                            RECOVR     4
C     PRINT STRESSES AND DEFLECTIONS                                         RECOVR     5
C                                                                            RECOVR     6
      COMMON/LOD/F(480),JDISP(30),S(6,6),RK(30,30),UR(160),U(480)            RECOVR     7
      COMMON/PDEL/R(160),RF(162)                                             RECOVR     8
      COMMON /IZO/ IN,IOUT                                                   RECOVR     9
      COMMON/PDDISP/NDDISP,I1DDSP(160),I2DDSP(160),DDISPY(160),DD1SPX(16     RECOVR    10
     *0)                                                                     RECOVR    11
      COMMON/NSX/NS,LUZ                                                      RECOVR    12
      COMMON/RCP/NCDES,NELEM,KODEBC(160),FDZ(160),FDR(160),NW                RECOVR    13
      COMMON /CURRZ/ TITLE(8)                                                RECOVR    14
      COMMON/PSOL/NN,MM,NNPE,NDOF,NVECT,LUK,LUR,INDEX17(821),INDEX19(41)     RECOVR    15
      COMMON/SET/NCDSET(160)                                                 DH3/22     2
      DIMENSION SPACE(480)                                                   RECOVR    16
      COMMON /FOILLY/ IFOIL,NODFL                                            RECOVR    17
      COMMON/EC/EC                                                           DH4/24    14
      COMMON/PLOTQ/IPLOT(2),IPRINT,MPRINT                                    DH4/23    44
      DIMENSION SPAC3(3,160)                                                 RECOVR    18
      DIMENSION FORCES(480)                                                  RECOVR    19
      EQUIVALENCE(SPACE,SPAC3)                                               RECOVR    20
C     RECOVER DEFLECTIONS                                                    RECOVR    21
      L= 1                                                                   RECOVR    22
      DO 100 I=1,NN                                                          RECOVR    23
      CALL READMS ( LUR, SPACE(L), NS, I)                                    RECOVR    24
  100 L= L + NS                                                              RECOVR    25
      DO 10 I=1,IFOIL                                                        RECOVR    26
      NODNM=(I-1)*NODFL+1                                                    RECOVR    27
   10 SPAC3(2,NODNM)=0.                                                      RECOVR    28
      DO 160 J=1,NCDES                                                       RECOVR    29
      CALL UNPCK60(KODEBC(J),I,2)                                            RECOVR    30
      IF(I.EQ.0)GO TO 160                                                    RECOVR    31
      SPAC3(2,J)=FDR(J)                                                      RECOVR    32
  160 CONTINUE                                                               RECOVR    33
      DO 101 IJ=1,NDDISP                                                     RECOVR    34
      N=IABS(I1DDSP(IJ))                                                     RECOVR    35
      M=IABS(I2DDSP(IJ))                                                     RECOVR    36
      SPAC3(2,N)=SPAC3(2,M)+DDISPY(IJ)                                       RECOVR    37
  101 CONTINUE                                                               RECOVR    38
      J=1                                                                    RECOVR    39
      DO 172 L=1,IFOIL                                                       RECOVR    40
      I1=(L-1)*NODFL+1                                                       RECOVR    41
      I2=L*NODFL                                                             RECOVR    42
      I3=(L-1)*NDOF*NODFL+1                                                  RECOVR    43
C      LOAD DELECTIONS INTO U ARRAY                                          RECOVR    44
      DO 171 I=I1,I2                                                         RECOVR    45
      RF(I)=R(I)-SPAC3(2,I)                                                  DH4/23    45
      DO 170 K=1,NDOF                                                        RECOVR    46
      U(J)=SPAC3(K,I)                                                        RECOVR    47
      J=J+1                                                                  RECOVR    48
  170 CONTINUE                                                               RECOVR    49
      UR(I)=SPAC3(2,I)                                                       RECOVR    50
  171 CONTINUE                                                               RECOVR    51
C      SOLVE FOR PRELOADS                                                    RECOVR    52
      NEQ=NODFL*NDOF                                                         RECOVR    53
      CALL VMULFF(RK,U(I3),NEQ,NEQ,1,30,480,FORCES(I3),480,IER)              RECOVR    54
```



62500

```
      172   CONTINUE                                                          RECOVR    55
      C      LOAD FORCES INTO F ARRAY                                         RECOVR    56
   60         DO 175 I=1,480                                                   RECOVR    57
              F(I)=FORCES(I)                                                   RECOVR    58
      175   CONTINUE                                                          RECOVR    59
            N1=J                                                              RECOVR    60
            IMS=0                                                             DH4/23    46
   65        IF(MPRINT.EQ.1.AND.IPRINT.GE.0)IMS=1                             DH4/23    47
            IF(MPRINT.EQ.0.AND.IPRINT.LT.0)IMS=2                              DH4/23    48
            IF(IPRINT.EQ.-1)IPRINT=0                                          DH4/24    15
            IF(IMS.EQ.0)GO TO 300                                             DH4/23    49
            WRITE(IOUT,80)                                                    RECOVR    61
   70       WRITE(IOUT,81) TITLE                                             RECOVR    62
            WRITE(IOUT,82)                                                    RECOVR    63
            IF(IMS.EQ.2)WRITE(61,220)EC                                       DH4/23    50
      220 FORMAT(1H ,*ECCENTRICITY = *,F7.4)                                  DH4/23    51
            DO 110 I=1,IFOIL                                                  RECOVR    64
   75       IF(IPRINT.EQ.0)WRITE(IOUT,201)I                                  DH4/14    18
            IF(IPRINT.NE.0)WRITE(IOUT,200)I                                   DH4/14    19
            J1=(I-1)*NODFL+1                                                  DH4/14    20
            J2=I*NODFL                                                        DH4/14    21
            DO 105 J=J1,J2                                                    DH4/14    22
   80       NUM=J                                                            DH4/14    23
            NFOR=J*NDOF-1                                                     DH4/14    24
            HC=1H                                                             DH3/22     3
            CALL UNPCK60(KODEBC(NUM),L,2)                                     DH3/22     4
            IF(L.EQ.1.AND.NODSET(NUM).EQ.0)HC=1HB                             DH3/22     5
   85       IF(L.EQ.1.AND.NODSET(NUM).NE.0)HC=1HS                             DH3/22     6
            DO 120 ITY=1,NDOISP                                               RECOVR    69
            I1=I1DDSP(ITY)                                                    RECOVR    70
            I2=IABS(I2DDSP(ITY))                                              RECOVR    71
            IF(I1.EQ.NUM)GO TO 130                                            RECOVR    72
   90       IF(I2.EQ.NUM)GO TO 140                                           RECOVR    73
      120   CONTINUE                                                          RECOVR    74
            TYPE=1H                                                           RECOVR    75
            ITY=0                                                             RECOVR    76
            GO TO 150                                                         RECOVR    77
   95 130   TYPE=1HD                                                         RECOVR    78
            HC=1H                                                             DH3/22     7
            GO TO 150                                                         RECOVR    79
      140   TYPE=1HI                                                        RECOVR    80
      150   CONTINUE                                                          RECOVR    81
  100       IF(IPRINT.EQ.0)WRITE(IOUT,211)J,R(J),SPAC3(2,J),RF(J),FORCES(NFOR)  DH4/14  26
           *,TYPE,ITY,HC                                                      DH4/14    27
            IF(IPRINT.EQ.0)GO TO 105                                          DH4/14    28
            WRITE(IOUT,210)J,(SPAC3(K,NUM),K=1,NDOF),FORCES(NFOR),TYPE,ITY,HC DH3/22     8
        105 CONTINUE                                                          RECOVR    83
  105   110 CONTINUE                                                          RECOVR    84
      C                                                                       RECOVR    85
            IF(IPRINT.EQ.0)GO TO 300                                          DH4/14    29
            DO 853 L=1,IFOIL                                                  RECOVR    86
            I1=(L-1)*NODFL+1                                                  RECOVR    87
  110       I2=L*NODFL                                                        RECOVR    88
            WRITE(61,850)                                                     RECOVR    89
      850   FORMAT(//,1H0,*NODE*,12X,*RINITIAL*,19X,*U*,14X,*RFINAL*,/,      RECOVR    90
           *1X,80(1H*),/)                                                     RECOVR    91
            DO 822 I=I1,I2                                                    RECOVR    92
```

```
      WRITE(61,851)I,R(I),SPAC3(2,I),RF(I)                                  RECOVR     95
  822 CONTINUE                                                              RECOVR     96
  851 FORMAT(1H ,I4,3F20.4)                                                 RECOVR     97
      WRITE(61,852)                                                         RECOVR     98
  853 CONTINUE                                                              RECOVR     99
  852 FORMAT(1H0,80(1H*))                                                   RECOVR    100
   80 FORMAT(1H1)                                                           RECOVR    101
   81 FORMAT(/,1X,8A10)                                                     RECOVR    102
   82 FORMAT(/,2X,*SYSTEM DESCRIPTION*//)                                   DH4/23     52
  200 FORMAT(/2X,*FOIL =*,I3,10X,*D.O.F. 1*,11X,*D.O.F. 2*,11X,             RECOVR    104
     + *D.O.F. 3*,11X,*RADIAL FORCE*,11X,*OVERLAP PAIRS*,3X,*B.C.*)         DH3/22      9
  210 FORMAT(4X,*NODE =*I3,4(4X,E15.7),10X,A1,I3,14X,A1)                    DH3/22     10
  211 FORMAT(4X,*NODE =*I3,4(F11.4,8X),10X,A1,I3,14X,A1)                    DH4/14     30
  201 FORMAT(/2X,*FOIL =*,I3,10X,*RINITIAL*,9X,*RADIAL DEFL*,10X,*RFINAL    DH4/14     31
     +*,13X,*RADIAL FORCE*,11X,*OVERLAP PAIRS*,3X,*B.C.*)                   DH4/14     32
  300 CONTINUE                                                              RECOVR    107
      END                                                                   RECOVR    108
```



62500

```
      OVERLAY(ISOFR1,6,4)                                              PLOTF    2
      PROGRAM PLOTF                                                    PLOTF    3
      COMMON/FOILLY/IFOIL,NODFL                                        PLOTF    4
      COMMON/RT/RS1,RB,R0,T,RFF,RL                                     PLOTF    5
      COMMON/LOD/DUM1(1606),U(480)                                     PLOTF    6
      COMMON/CURBMZ/DUM2(38),FNOA(10)                                  PLOTF    7
      COMMON/PSOL/NN,MM,NNPE,NDOF                                      PLOTF    8
      COMMON/PLOT/XL(4),YL(4),ANGLE(12)                                PLOTF    9
      COMMON/PDEL/XR(160),R(162),URASS(10),RFREE(10)                   DH3/19   9
      COMMON/PLOTQ/IPLOT,NPLOT                                         DH3/19   10
      COMMON/SHAFT/RP                                                  PLOTF    11
      DIMENSION RBIG(12)                                               PLOTF    12
C                                                                      PLOTF    13
C                                                                      PLOTF    14
      CALL MEMSET(XL(1),ANGLE(12),0.)                                  PLOTF    15
      PI=3.1415926536                                                  PLOTF    16
      RS=2.25                                                          PLOTF    17
C      PLOT 1 IS PLOT OF WHOLE BEARING                                 PLOTF    18
      XCOR=2.*RB                                                       PLOTF    19
      YCOR=XCOR                                                        PLOTF    20
      CALL PLOT(XCOR,YCOR,-3)                                          PLOTF    21
      FMULT=1.                                                         PLOTF    22
      CALL FACTOR(FMULT)                                               PLOTF    23
      CALL CIRCLE(RB,0.,0.,360.,RB,RB,0.0)                             PLOTF    24
      CALL CIRCLE(RS,0.,0.,360.,RS,RS,0.0)                             PLOTF    25
      ZETA=0.0                                                         PLOTF    26
      RFOIL=IFOIL                                                      PLOTF    27
      DO 100 I=1,IFOIL                                                 PLOTF    28
      DO 90 J=1,NODFL                                                  PLOTF    29
      JI=(I-1)*NODFL+J                                                 PLOTF    30
      J1=J*NDOF-2                                                      PLOTF    31
      J2=J*NDOF-1                                                      PLOTF    32
      THETA=FNOA(J)+(I-1)*2.*3.1415926536/RFOIL                        PLOTF    33
      ZETA=ACOS((RFREE(J)-URASS(J))/R(JI))                             DH3/19   11
      ANGLE(J)=PI/2.-(THETA+ZETA)                                      PLOTF    35
      WRITE(61,900)J,R(JI),ANGLE(J),THETA,ZETA                         PLOTF    36
   90 CONTINUE                                                         PLOTF    37
      NODES=IFOIL*NODFL                                                PLOTF    38
      ANGLE(NODFL+1)=0.                                                PLOTF    39
      R(NODES+1)=0.                                                    PLOTF    40
      ANGLE(NODFL+2)=1.                                                PLOTF    41
      R(NODES+2)=1.                                                    PLOTF    42
      CALL TLINE(ANGLE,R((I-1)*NODFL+1),NODFL,1,1,0)                   PLOTF    43
  100 CONTINUE                                                         PLOTF    44
C                                                                      PLOTF    45
C      PLOT 2 IS AN ENLARGED PLOT SHOWING HALF A BEARING               PLOTF    46
C      FAC IS MULT. FACTOR TO ENLARGE PLOT 2.                          PLOTF    47
      FAC=8.5                                                          PLOTF    48
      XCOR=2.*RB*FAC                                                   PLOTF    49
      CALL PLOT(XCOR,0.,-3)                                            PLOTF    50
      CALL FACTOR(FMULT)                                               PLOTF    51
      PHI=360./RFOIL                                                   PLOTF    52
      ZETA=3.*PHI                                                      PLOTF    53
      THO=180.-ZETA                                                    PLOTF    54
      THF=180.                                                         PLOTF    55
      X0=-RB*FAC*COS(ZETA)                                             PLOTF    56
      Y0=RB*FAC*SIN(ZETA)                                              PLOTF    57
```

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0 0 5 2 9

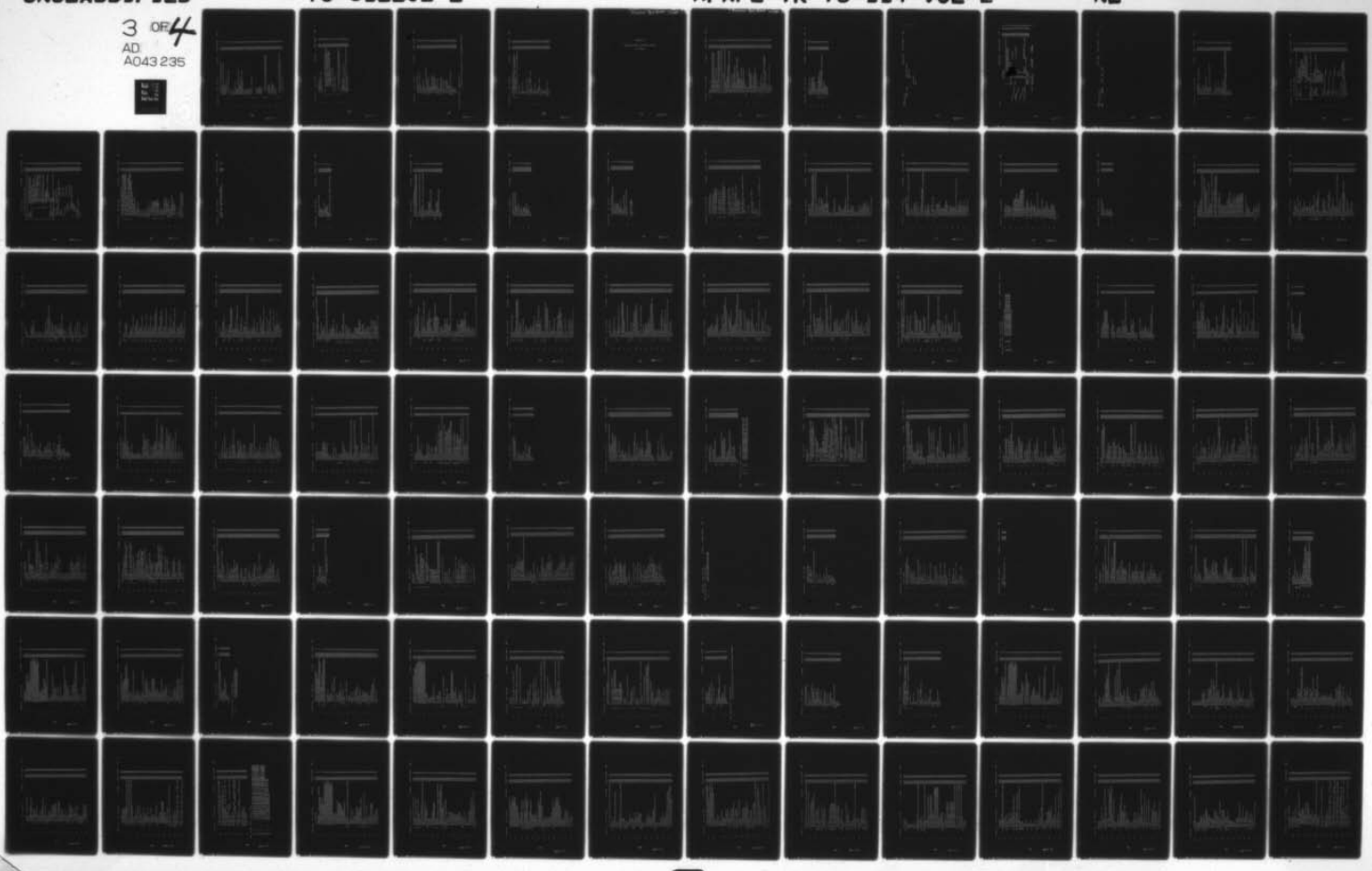
```
                XC=RB*FAC                                                       PLOTF   58
                CALL CIRCLE(0.,XC,90.,180.,XC,XC,0.0)                           PLOTF   59
 60             IRP=LEGVAR(RP)                                                  PLOTF   60
                IF(IRP.NE.0)GO TO 110                                           PLOTF   61
                XC=RP*FAC                                                       PLOTF   62
                CALL CIRCLE(0.,XC,90.,180.,XC,XC,0.0)                           PLOTF   63
            110 CONTINUE                                                        PLOTF   64
 65             IFOIL2=IFOIL/2                                                  PLOTF   65
                KFOIL=2                                                         PLOTF   66
                DO 200 I=1,KFOIL                                                PLOTF   67
                DO 190 J=1,NODFL                                                PLOTF   68
                JI=(I-1)*NODFL+J                                                PLOTF   69
 70             J1=J*NDOF-2                                                     PLOTF   70
                J2=J1*NDOF-1                                                    PLOTF   71
                THETA=FNOA(J)+(I-1)*2.*3.1415926536/RFOIL-3.1415926536/2.       PLOTF   72
                UR=U(J2)+URASS(J)                                               DH3/19  12
                IF(NPLOT.EQ.1)UR=URASS(J)                                       DH3/19  13
 75             ZETA=ACOS((RFREE(J)-UR)/R(JI))                                  DH3/19  14
                ANGLE(J)=PI/2.-(THETA+ZETA)                                     PLOTF   75
                WRITE(61,900)J,R(JI),ANGLE(J),THETA,ZETA                        PLOTF   76
                RBIG(J)=R(JI)*FAC                                               PLOTF   77
            190 CONTINUE                                                        PLOTF   78
 80             RBIG(NODFL+1)=0.                                                PLOTF   79
                RBIG(NODFL+2)=1.                                                PLOTF   80
                CALL TLINE(ANGLE,RBIG,NODFL,1,1,0)                              PLOTF   81
                THETA=FNOA(1)+(I-1)*2.*3.1415926536/RFOIL-3.1415926536/2.       PLOTF   82
                XINC=T*COS(THETA)*FAC                                           PLOTF   83
 85             YINC=T*SIN(THETA)*FAC                                           PLOTF   84
                XL(1)=RBIG(1)*COS(ANGLE(1))+XINC                                PLOTF   85
                XL(2)=RBIG(1)*COS(ANGLE(1))                                     PLOTF   86
                XL(3)=0.                                                        PLOTF   87
                XL(4)=1.                                                        PLOTF   88
 90             YL(1)=RBIG(1)*SIN(ANGLE(1))+YINC                                PLOTF   89
                YL(2)=RBIG(1)*SIN(ANGLE(1))                                     PLOTF   90
                YL(3)=0.                                                        PLOTF   91
                YL(4)=1.                                                        PLOTF   92
                CALL LINE(XL,YL,2,1,0,0)                                        PLOTF   93
 95             DO 195 K=1,NODFL                                                PLOTF   94
                RBIG(K)=RBIG(K)+T*FAC                                           PLOTF   95
            195 CONTINUE                                                        PLOTF   96
                CALL TLINE(ANGLE,RBIG,NODFL,1,0,0)                              PLOTF   97
                THETA=FNOA(NODFL)+(I-1)*2.*3.1415926536/RFOIL-3.1415926536/2.   PLOTF   98
100             XINC=T*COS(THETA)*FAC                                           PLOTF   99
                YINC=T*SIN(THETA)*FAC                                           PLOTF  100
                XL(1)=RBIG(NODFL)*COS(ANGLE(NODFL))                             PLOTF  101
                XL(2)=RBIG(NODFL)*COS(ANGLE(NODFL))-XINC                        PLOTF  102
                YL(1)=RBIG(NODFL)*SIN(ANGLE(NODFL))                             PLOTF  103
105             YL(2)=RBIG(NODFL)*SIN(ANGLE(NODFL))-YINC                        PLOTF  104
                CALL LINE(XL,YL,2,1,0,0)                                        PLOTF  105
            200 CONTINUE                                                        PLOTF  106
                CALL PLOT(XCOR,0.,-3)                                           PLOTF  107
                CALL FACTOR(FMULT)                                              PLOTF  108
110         900 FORMAT(1H0,*NODE,R,ANGLE,THETA,ZETA  =  *,I4,4E15.5)            PLOTF  109
                END                                                             PLOTF  110
```

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00 529 0

AD-A043 235 AIRESEARCH MFG CO OF ARIZONA PHOENIX F/G 13/9
GAS LUBRICATED FOIL BEARING DEVELOPMENT FOR ADVANCED TURBOMACHI--ETC(U)
APR 77 E S ZORZI F33615-73-C-2058
UNCLASSIFIED 76-312202-2 AFAPL-TR-76-114-VOL-2 NL

3 OF 4
AD
A043 235



```
      SUBROUTINE TLINE (XARAY,YARAY,LPTS,INC,LYNTYP,LSYM)                    TLINE      2
      COMMON IN,OUT                                                          TLINE      3
      DIMENSION XX(302),YY(302),L(2),XARAY(1),YARAY(1)                       TLINE      4
      INTEGER OUT                                                            TLINE      5
      NPTS=IABS(LPTS)                                                        TLINE      6
      IF (LYNTYP.LT.0) GO TO 30                                              TLINE      7
C                                                                            TLINE      8
C       CORRECTION FOR EQUAL VALUES IN XARAY                                 TLINE      9
C                                                                            TLINE     10
      IFLAG=0                                                                TLINE     11
      I=0                                                                    TLINE     12
    3 CONTINUE                                                               TLINE     13
      I=I+1                                                                  TLINE     14
      IF(I.EQ.NPTS) GO TO 7                                                  TLINE     15
      ISAVE=I                                                                TLINE     16
    4 CONTINUE                                                               TLINE     17
      IF((XARAY(I)-XARAY(I+1)).NE.0.0) GO TO 6                               TLINE     18
      IFLAG=IFLAG+1                                                          TLINE     19
      XARAY(I)=XARAY(I)/1.0001                                               TLINE     20
      IF(XARAY(I).EQ.0.0) XARAY(I)=-0.0001                                   TLINE     21
      IF(I.EQ.1) GO TO 5                                                     TLINE     22
      I=I-1                                                                  TLINE     23
      GO TO 4                                                                TLINE     24
    5 CONTINUE                                                               TLINE     25
      I=ISAVE                                                                TLINE     26
    6 CONTINUE                                                               TLINE     27
      GO TO 3                                                                TLINE     28
    7 CONTINUE                                                               TLINE     29
      IF(IFLAG.GT.0) WRITE(OUT,40)                                           TLINE     30
C                                                                            TLINE     31
C                                                                            TLINE     32
C                                                                            TLINE     33
      L(1)=NPTS                                                              TLINE     34
      L(2)=3                                                                 TLINE     35
      NARAY=300                                                              TLINE     36
      NM1=NARAY-1                                                            TLINE     37
      NP2=NARAY+2                                                            TLINE     38
      ANM1=NM1                                                               TLINE     39
C                                                                            TLINE     40
C                                                                            TLINE     41
C       PUT THE FIRST AND LAST POINTS FROM XARAY AND YARAY INTO              TLINE     42
C          XX AND YY, AND ALSO MOVE THE ORIGIN AND SCALE FACTORS             TLINE     43
C                                                                            TLINE     44
      XX(1)=XARAY(1)                                                         TLINE     45
      YY(1)=YARAY(1)                                                         TLINE     46
      M=NPTS                                                                 TLINE     47
      DO 10 J=NARAY,NP2                                                      TLINE     48
      XX(J)=XARAY(M)                                                         TLINE     49
      YY(J)=YARAY(M)                                                         TLINE     50
      M=M+1                                                                  TLINE     51
   10 CONTINUE                                                               TLINE     52
C                                                                            TLINE     53
C                                                                            TLINE     54
C       CREATE AN ARRAY OF 300 POINTS EQUALLY SPACED ON THE X AXIS BY        TLINE     55
C          CALLING THE LAGRANGIAN INTERPOLATION ROUTINE TABX                 TLINE     56
C                                                                            TLINE     57
      DX=(XX(NARAY)-XX(1))/ANM1                                              TLINE     58
```



62500

```
                      DO 20 I=2,NM1                                                    TLINE     59
                      XX(I)=(I-1)*DX+XX(1)                                             TLINE     60
                      YY(I)=TABX(XARAY,YARAY,XX(I),L)                                  TLINE     61
   60                 20 CONTINUE                                                      TLINE     62
                                                                                       TLINE     63
                   C                                                                   TLINE     64
                   C                                                                   TLINE     65
                   C    LINE IS CALLED WITH THE ARRAYS OF 300 POINTS, AND A LINE IS    TLINE     66
                   C            DRAWN POINT TO POINT.  IF THE CURVE IS LESS THAN 30 INCHES TLINE  67
   65              C            IN LENGTH, AND DOESNT HAVE RAPID CHANGES IN SLOPE,     TLINE     68
                   C            IT WILL APPEAR SMOOTH.   IF IT IS NOT SMOOTH, INCREASE TLINE     69
                   C            THE ARRAY SIZE ACCORDINGLY BY INCREASING NARAY AND     TLINE     70
                   C            THE DIMENSIONS OF XX AND YY.                           TLINE     71
   70              C                                                                   TLINE     72
                      CALL POLAR(YY,XX,NARAY,INC,-1,0.,1.)                             TLINE     73
                   C                                                                   TLINE     74
                      IF (LYNTYP.EQ.0) RETURN                                          TLINE     75
                   C                                                                   TLINE     76
   75              C                                                                   TLINE     77
                   C     LINE IS CALLED TO PLOT SYMBOLS AT THE INPUT POINTS IF REQUESTED TLINE     78
                   C            EVERY JTH POINT IN THE XARAY, YARAY IS PLOTTED.        TLINE     79
                   C                                                                   TLINE     80
                      30 CONTINUE                                                      TLINE     81
   80                 J=IABS(LYNTYP)*(-1)                                              TLINE     82
                      CALL POLAR(YARAY,XARAY,LPTS,INC,LSYM,0.,1.)                      TLINE     83
                      RETURN                                                           TLINE     84
                   40 FORMAT(1X,*ADJUSTMENTS HAVE BEEN MADE TO SUCCESSIVE EQUAL XARAY VA TLINE  85
                     1LUES FOR PLOTTING ONLY*)                                         TLINE     86
   85                 END
```



00529

```
      FUNCTION TABX (XTAB,YTAB,O,L)                                    TLINE    87
      INTEGER OUT                                                      TLINE    88
      DIMENSION XTAB(2), YTAB(2), L(2)                                 TLINE    89
      COMMON IN,OUT                                                    TLINE    90
      K=L(1)                                                           TLINE    91
      IF (L(1)-1) 10,10,20                                             TLINE    92
   10 TABX=YTAB(1)                                                     TLINE    93
      RETURN                                                           TLINE    94
   20 CALL BISC (XTAB,O,L(1),KBOTM,KTOP,JJ)                            TLINE    95
      IF (JJ-1) 30,80,80                                               TLINE    96
   30 IF (KTOP-KBOTM) 80,80,40                                         TLINE    97
   40 CONTINUE                                                         TLINE    98
      NORDE=L(2)                                                       TLINE    99
      NORDE=MIN0(L(2),(L(1)-1))                                        TLINE   100
      IF ((NORDE).LE.1) GO TO 80                                       TLINE   101
      IF ((NORDE).GE.3) GO TO 70                                       TLINE   102
      GO TO (80,50,70), NORDE                                          TLINE   103
   50 KTOP=KTOP+1                                                      TLINE   104
      IF (KTOP-K) 80,80,60                                             TLINE   105
   60 KTOP=K                                                           TLINE   106
      GO TO 80                                                         TLINE   107
   70 KTOP=MIN0((KTOP+1),L(1))                                         TLINE   108
      KBOTM=MAX0((KBOTM-1),1)                                          TLINE   109
   80 Z=0.                                                             TLINE   110
      DO 120 J=KBOTM,KTOP                                              TLINE   111
      P=1.0                                                            TLINE   112
      DO 110 I=KBOTM,KTOP                                              TLINE   113
      IF (I-J) 100,90,100                                              TLINE   114
   90 P=P*YTAB(J)                                                      TLINE   115
      GO TO 110                                                        TLINE   116
  100 P=P*(O-XTAB(I))/(XTAB(J)-XTAB(I))                                TLINE   117
  110 CONTINUE                                                         TLINE   118
  120 Z=Z+P                                                            TLINE   119
      TABX=Z                                                           TLINE   120
      RETURN                                                           TLINE   121
      END                                                              TLINE   122
```

CARD NR. SEVERITY DETAILS DIAGNOSIS OF PROBLEM

17 I AN IF STATEMENT MAY BE MORE EFFICIENT THAN A 2 OR 3 BRANCH COMPUTED GO TO STATEMENT.



62500

```
      SUBROUTINE HISC (Y,X,N,IL,IH,J)                                    TLINE     123
C ROUTINE TO SEARCH A VECTOR Y OF N VALUES TO FIND THE VALUES Y(IL)       TLINE     124
C     AND Y(IH) WHICH BRACKET THE NUMBER X.  IL IS LESS THAN IH.          TLINE     125
C     IF X = Y(I), IL = IH = I.                                           TLINE     126
C     IF X IS NOT IN RANGE, IL = IH = 1 IF NEAREST Y(1), OTHERWISE = N.   TLINE     127
C                                                                         TLINE     128
      DIMENSION Y(2)                                                      TLINE     129
      J=0                                                                 TLINE     130
      S=1.                                                                TLINE     131
      S=SIGN(S,Y(N)-Y(1))                                                 TLINE     132
      IL=1                                                                TLINE     133
      IH=N                                                                TLINE     134
      I=1                                                                 TLINE     135
      IF (S*(X-Y(1))) 20,60,10                                            TLINE     136
   10 I=N                                                                 TLINE     137
      IF (S*(X-Y(N))) 40,60,30                                            TLINE     138
C     RETURN       IF NUMBER NOT IN TABLE.                                TLINE     139
   20 IH=MIN0(2,N)                                                        TLINE     140
      J=1                                                                 TLINE     141
      RETURN                                                              TLINE     142
   30 IL=MAX0((N-1),1)                                                    TLINE     143
      J=2                                                                 TLINE     144
      RETURN                                                              TLINE     145
   40 I=(IL+IH)/2                                                         TLINE     146
      IF (S*(X-Y(I))) 50,60,70                                            TLINE     147
   50 IH=I                                                                TLINE     148
      GO TO 80                                                            TLINE     149
   60 IL=I                                                                TLINE     150
      IH=I                                                                TLINE     151
      RETURN                                                              TLINE     152
   70 IL=I                                                                TLINE     153
   80 IF (IL+1-IH) 40,90,90                                               TLINE     154
   90 RETURN                                                              TLINE     155
      END                                                                 TLINE     156
```

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62500

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# APPENDIX B

## JOURNAL BEARING PROGRAM LISTING

(93 PAGES)



62500

```
      C$    DEBUG                                                          CURBM      2
      C$    ARRAYS                                                         CURBM      3
            OVERLAY(ISOFR1,0,0)                                            CURBM      4
            PROGRAM CURBM (INPUT=65,OUTPUT=65,TAPE60=INPUT,TAPE61=OUTPUT,  CURBM      5
     5     +TAPE3=0,TAPE7=0,TAPE15,TAPE10,TAPE17=0,TAPE19=0,DEBUG=OUTPUT)  CURBM      6
            COMMON /IZO/ IN,IOUT                                           CURBM      7
            COMMON /BILL/ LURA(1478),IREAD,IWRITE                          CURBM      8
            COMMON/NSX/NS,LUZ                                              CURBM      9
            COMMON/SYMSOL/NN,MM,NNPE,NDOF,NVECT,NODES,NELEM,NW,LUT,LUK,LUE,CURBM     10
     10    +LUR,INDEX3(41),INDEX7(146),INDEX17(821),INDEX19(41),KRECRD(820),CURBM     11
           +NEQ                                                            CURBM     12
            COMMON/PDDISP/NDDISP,I1DDSP(160),I2DDSP(160),DDISPY(160),DDISPX(16CURBM    13
           +0)                                                             CURBM     14
            COMMON/SET/NCUSET(160),NNODST                                  CURBM     15
     15     COMMON/CURBMZ/TITLE(8),ICM(30),FNOA(160),NB(145,2),SM(3,3),SMT(3,3CURBM    16
           +),SMS(6,6),S(6,6)                                              CURBM     17
            COMMON /DEFLEC/ SPACE(30)                                      CURBM     18
            COMMON/FOILLY/IFOIL,NODEL,N,M,N1,N2,M1,M2                      CURBM     19
            COMMON/HOLER/H2(5,82),X2(5,82),C2(5,82),BETA2(82),NE,ME,NE1,NE2,CURBM     20
     20    +ME1,ME2                                                        CURBM     21
            COMMON/RT/RS1,RB,R0,T,RFF,RL                                   CURBM     22
            COMMON/L/AL,TC                                                 CURBM     23
            COMMON/ITER/ITERATE,LIM,ERROR                                  CURBM     24
            COMMON/BCP/KODEBC(160),FDZ(160),FDR(160)                       CURBM     25
     25     COMMON/EC/EC,PSI                                               CURBM     26
            COMMON/PDEL/R(160),RF(162),RSP(160),URASS(10),RASS(10)         CURBM     27
            COMMON/KEY/NODEE(82),NODEH(160)                                CURBM     28
             COMMON/FOR/HFORCE(160)                                        CURBM     29
            COMMON/ECC/THETA(160)                                          CURBM     30
     30     COMMON/PLOTQ/IPLOT,NPLOT,IPRINT,MPRINT                         CURBM     31
            DATA IN,IOUT/60,61/                                            CURBM     32
            DATA LUT,LUK,LUE,LUR,LUZ/3,4,7,13,15/                          CURBM     33
            DO 9999 I=1,1478                                               CURBM     34
     9999    LURA(I)=0.                                                    CURBM     35
     35     IREAD=0                                                        CURBM     36
             IWRITE=0                                                      CURBM     37
            CALL MEMSET(INDEX3(1),INDEX19(41),0)                           CURBM     38
            CALL OPENMS (LUE,INDEX7,146,0)                                 CURBM     39
            CALL OPENMS(LUT,INDEX3,41,0)                                   CURBM     40
     40     CALL ETIME                                                     CURBM     41
            READ(60,4)(TITLE(I),I=1,8)                                     CURBM     42
            READ(60,5)RFOIL,RNOD,RB,AL,T,TC,RL,RFF                         CURBM     43
            READ(60,6)IPLOT,IPRINT,MPRINT                                  CURBM     44
            IF(EOF(60))20,30                                               CURBM     45
     45     20    IPLOT=0                                                  CURBM     46
            30    CONTINUE                                                 CURBM     47
                  WRITE(61,10)TITLE                                        CURBM     48
               10 FORMAT(1H1,8A10,/,132(1H*))                              CURBM     49
                  WRITE(61,11)                                             CURBM     50
     50     11    FORMAT(1H0,*NO. OF FOILS   NODES/FOIL   BEARING RADIUS*  CURBM     51
           +*   AXIAL LENGTH   FOIL THICKNESS   COATING THICKNESS   *      CURBM     52
           +*FOIL ARCLENGTH   FREE FOIL R*)                                CURBM     53
            IFOIL=RFOIL                                                    CURBM     54
            NODEL=RNOD                                                     CURBM     55
     55     WRITE(61,12)IFOIL,NODEL,RB,AL,T,TC,RL,RFF                      CURBM     56
            WRITE(61,13)                                                   CURBM     57
            ITERATE=0                                                      CURBM     58
```



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```
      LIM=25                                                            CURBM      59
      CALL OVERLAY(6HISOFB1,1,0)                                        CURBM      60
   40 CONTINUE                                                          CURBM      61
      CALL OVERLAY(6HISOFB1,4,0)                                        CURBM      62
      IF(ITERATE.GE.LIM)GO TO 50                                        CURBM      63
      CALL OVERLAY(6HISOFB1,5,0)                                        CURBM      64
      ITERATE=ITERATE+1                                                 CURBM      65
      GO TO 40                                                          CURBM      66
   50 CONTINUE                                                          CURBM      67
      WRITE(6,8888) IREAD,IWRITE                                        CURBM      68
 8888 FORMAT(* INCORE READS ON LUR =*,I10,                              CURBM      69
     +*   INCORE WRITES ON LUR  = *,I10)                               CURBM      70
   12 FORMAT(1H ,4X,I2,14X,I2,10X,2(F9.5,7X),F9.5,8X,F9.5,11X,F9.5      CURBM      71
     +,8X,F9.5)                                                         CURBM      72
   13 FORMAT(1H0,132(1H*))                                              CURBM      73
    5 FORMAT(8F10.5)                                                    CURBM      74
    6 FORMAT(3I5)                                                       CURBM      75
    4 FORMAT(8A10)                                                      CURBM      76
      END                                                               CURBM      77
```

MEMSET
STORAGE ALLOCATION.

| ADDRESS | LENGTH | BINARY CONTROL CARDS. | |
|---|---|---|---|
| | | | 1 |
| 0 | 5 | IDENT MEMSET | 3 |
| 5 | | END | 4 |
| | | | 7 |
| | | ENTRY POINTS. | |
| | | | 9 |
| | | MEMSET 1* | |



62500

```
                                IDENT MEMSET                                                    CUHBM    78   1
                                ENTRY MEMSET                                                    CUHBM    79   2
                           *                                                                    CUHBM    80   3
                           *                    FTN EXTENDED CALLABLE ROUTINE TO SET CM TO VALUE P3   CUHBM    81   4
                           *                    FROM P1 LOCATION THROUGH P2 LOCATION            CUHBM    82   5
                           *                       CALL MEMSET (START, END, VALUE)              CUHBM    83   6
                           *                                                                    CUHBM    84   7
                           **TIGHTER CODE          --  06/08/71                                  CUHBM    85   8
0  56610                   LOOP     SA6    B1                                                   CUHBM    86   9
       66113                        SB1    B1+B3                  .B3=1 ALWAYS                  CUHBM    87  10
            0621000000 +            GE     B2,B1,LOOP                                           CUHBM    88  11
1  0000000000              MEMSET   PS                                                          CUHBM    89  12
2  6130000001                       SB3    1                      .SET UP PARAMETERS            CUHBM    90  13
            54213                   SA2    A1+B3                                                CUHBM    91  14
                 54323              SA3    A2+B3                                                CUHBM    92  15
3  53330                            SA3    X3                                                   CUHBM    93  16
       10633                        BX6    X3                                                   CUHBM    94  17
            63110                   SB1    X1                                                   CUHBM    95  18
                 63220              SB2    X2                                                   CUHBM    96  19
4  0621000000 +                     GE     B2,B1,LOOP             .RETURN IF P2.LT.P1           CUHBM    97  20
            0400000001 +            EQ     MEMSET                 .P2 WAS .LT. P1 / ERROR / RETURN  CUHBM  98  21
                           **6400 TIMES IN MICROSECONDS  --  OLD/NEW                            CUHBM    99  22
                           **SET-UP   3.5/6.0                                                   CUHBM   100  23
                           **PER LOOP   4.8/2.8                                                 CUHBM   101  24
5                                   END                                                         CUHBM   102  25

                 45200B CM  STORAGE USED              25 STATEMENTS        2 SYMBOLS                  27
                            MODEL 73 ASSEMBLY      0.218 SECONDS          6 REFERENCES               28
```



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MEMSET
SYMBOLIC REFERENCE TABLE.

| | | | | | | |
|---|---|---|---|---|---|---|
| LOOP | 0 | PROGRAM* | 2/09 L | 2/11 | 2/20 | 1 |
| MEMSET | 1 | PROGRAM* | 2/02 E | 2/12 L | 2/21 | 2 |

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62500

```
      SUBROUTINE ETIME                                                  ETIME      2
C     ETIME REPLACES THE OLD 3400 ROUTINE TIME                          ETIME      3
      REAL L,LL,NS                                                      ETIME      4
      DATA M/1/                                                         ETIME      5
C     DATA(M=1)                                                         ETIME      6
C     DATA (HOLLERITH)                                                  ETIME      7
      CALL DATE (I)                                                     ETIME      8
      I=SHIFT(I,6)                                                      ETIME      9
C     WALL - CLOCK TIME (HOLLERITH)                                     ETIME     10
      CALL TIME(K)                                                      ETIME     11
      K=SHIFT(K,6)                                                      ETIME     12
C     CPU TIME USED (REAL, SECONDS AND MILLISECONDS)                    ETIME     13
      CALL SECOND(L)                                                    ETIME     14
      NM=0                                                              ETIME     15
      NH=0                                                              ETIME     16
      NS=0.0                                                            ETIME     17
      IF (M.EQ.1) GO TO 30                                              ETIME     18
      NS=ABS (L-LL)                                                     ETIME     19
      NM=NS/60.0                                                        ETIME     20
      IF (NM.EQ.0) GO TO 30                                             ETIME     21
      NS=NS-(NM*60)                                                     ETIME     22
      NS=NM/60                                                          ETIME     23
      IF (NH.EQ.0) GO TO 30                                             ETIME     24
      NM=NM-NH*60                                                       ETIME     25
   30 PRINT 99, I,K,NH,NM,NS,M                                          ETIME     26
   99 FORMAT (8H ETIME. ,6H DATE ,A8,8H.  TIME ,A8,35H.  ELAPSED CPU TIM ETIME     27
     +E SINCE LAST CALL  ,I3,4H HRS,I3,4H MIN,F6.3,18H SEC. THIS IS CALL ETIME     28
     +,I5,1H.)                                                          ETIME     29
      M=M+1                                                             ETIME     30
      LL=L                                                              ETIME     31
      RETURN                                                            ETIME     32
      END                                                               ETIME     33
```



62500

```
      SUBROUTINE UERTST (IER,NAME)                                      UERTST     2
C                                                                       UERTST     3
C-UERTST----------LIBRARY 3---------------------------------------------UERTST     4
C                                                                       UERTST     5
C   FUNCTION            - ERROR MESSAGE GENERATION                      UERTST     6
C   USAGE               - CALL UERTST(IER,NAME)                         UERTST     7
C   PARAMETERS   IER    - ERROR PARAMETER. TYPE + N  WHERE              UERTST     8
C                           TYPE= 128 IMPLIES TERMINAL ERROR            UERTST     9
C                                 64 IMPLIES WARNING WITH FIX           UERTST    10
C                                 32 IMPLIES WARNING                    UERTST    11
C                           N   = ERROR CODE RELEVANT TO CALLING ROUTINE UERTST    12
C                NAME   - INPUT SCALAR CONTAINING THE NAME OF THE       UERTST    13
C                           CALLING ROUTINE AS A 6-CHARACTER LITERAL    UERTST    14
C                           STRING.                                     UERTST    15
C   LANGUAGE            - FORTRAN                                       UERTST    16
C-------------------------------------------------------------------------UERTST    17
C   LATEST REVISION     - AUGUST 1, 1973                                UERTST    18
C                                                                       UERTST    19
      DIMENSION          ITYP(2,4),IBIT(4)                            UERTST    20
      INTEGER            WARN,WARF,TERM,PRINTR                        UERTST    21
      EQUIVALENCE        (IBIT(1),WARN),(IBIT(2),WARF),(IBIT(3),TERM) UERTST    22
      DATA      ITYP      /10HWARNING   ,10H           ,              UERTST    23
     *                    10HWARNING(WI,10HTH FIX)    ,              UERTST    24
     *                    10HTERMINAL   ,10H           ,              UERTST    25
     *                    10HNON-DEFINE,10HD          /,              UERTST    26
     *          IBIT      / 32,64,128,0/                               UERTST    27
      DATA               PRINTR/6LOUTPUT/                             UERTST    28
      IER2=IER                                                        UERTST    29
      IF (IER2 .GE. WARN) GO TO 5                                     UERTST    30
C                                        NON-DEFINED                    UERTST    31
      IER1=4                                                          UERTST    32
      GO TO 20                                                        UERTST    33
    5 IF (IER2 .LT. TERM) GO TO 10                                    UERTST    34
C                                        TERMINAL                       UERTST    35
      IER1=3                                                          UERTST    36
      GO TO 20                                                        UERTST    37
   10 IF (IER2 .LT. WARF) GO TO 15                                    UERTST    38
C                                        WARNING(WITH FIX)              UERTST    39
      IER1=2                                                          UERTST    40
      GO TO 20                                                        UERTST    41
C                                        WARNING                        UERTST    42
   15 IER1=1                                                          UERTST    43
C                                        EXTRACT *N*                    UERTST    44
   20 IER2=IER2-IBIT(IER1)                                            UERTST    45
C                                        PRINT ERROR MESSAGE            UERTST    46
      WRITE (PRINTR,25) (ITYP(I,IER1),I=1,2),NAME,IER2,IER            UERTST    47
   25 FORMAT(26H *** I M S L(UERTST) ***  ,2A10,4X,A6,4X,I2,          UERTST    48
     1   8H (IER = ,I3,1H))                                           UERTST    49
      RETURN                                                          UERTST    50
      END                                                             UERTST    51
```

```
      SUBROUTINE VMULFF (A,B,L,M,N,IA,IB,C,IC,IER)                      VMULFF     2
C                                                                       VMULFF     3
C-VMULFF--------S-------LIBRARY 3---------------------------------------VMULFF     4
C                                                                       VMULFF     5
C   FUNCTION              - MATRIX MULTIPLICATION-FULL STORAGE MODE      VMULFF     6
C   USAGE                 - CALL VMULFF (A,B,L,M,N,IA,IB,C,IC,IER)      VMULFF     7
C   PARAMETERS   A        - FIRST MATRIX (A IS L X M)                   VMULFF     8
C                B        - SECOND MATRIX (B IS M X N)                  VMULFF     9
C                L        - MAXIMUM VALUE OF FIRST SUBSCRIPT OF A       VMULFF    10
C                M        - MAXIMUM VALUE OF SECOND SUBSCRIPT OF A AND  VMULFF    11
C                             FIRST SUBSCRIPT OF B                      VMULFF    12
C                N        - MAXIMUM VALUE OF SECOND SUBSCRIPT OF B      VMULFF    13
C                IA       - VALUE OF FIRST INDEX IN DIMENSION STATEMENT VMULFF    14
C                             FOR A                                     VMULFF    15
C                IB       - VALUE OF FIRST INDEX IN DIMENSION STATEMENT VMULFF    16
C                             FOR B                                     VMULFF    17
C                C        - RESULT MATRIX (C IS L X N)                  VMULFF    18
C                IC       - VALUE OF FIRST INDEX IN DIMENSION STATEMENT VMULFF    19
C                             FOR C                                     VMULFF    20
C                IER      - ERROR PARAMETER.                            VMULFF    21
C                           TERMINAL ERROR=128+N.                       VMULFF    22
C                             N = 1 INDICATES A,B,OR C WAS DIMENSIONED  VMULFF    23
C                                 INCORRECTLY                           VMULFF    24
C                                                                       VMULFF    25
C   PRECISION             - SINGLE                                      VMULFF    26
C   REQD. IMSL ROUTINES   - UERTST                                      VMULFF    27
C   LANGUAGE              - FORTRAN                                     VMULFF    28
C---------------------------------------------------------------------- VMULFF    29
C   LATEST REVISION       - FEBRUARY 27,1974                            VMULFF    30
C                                                                       VMULFF    31
      DIMENSION           A(IA,1),B(IB,1),C(IC,1)                       VMULFF    32
      DOUBLE PRECISION    TEMP                                          VMULFF    33
      IF (IA .GE. L .AND. IB .GE. M .AND. IC .GE. L) GO TO 5            VMULFF    34
C                                     TERMINAL ERROR                    VMULFF    35
      IER=129                                                           VMULFF    36
      GO TO 9000                                                        VMULFF    37
C                                     ROW INDICATOR                     VMULFF    38
    5 IER = 0                                                           VMULFF    39
        DO 15 I=1,L                                                     VMULFF    40
C                                     COLUMN INDICATOR                  VMULFF    41
          DO 15 J=1,N                                                   VMULFF    42
          TEMP=0.0D0                                                    VMULFF    43
C                                     VECTOR DOT PRODUCT                VMULFF    44
            DO 10 K=1,M                                                 VMULFF    45
            TEMP=DBLE(A(I,K))*DBLE(B(K,J))+TEMP                         VMULFF    46
   10       CONTINUE                                                    VMULFF    47
          C(I,J)=TEMP                                                   VMULFF    48
   15   CONTINUE                                                        VMULFF    49
      GO TO 9005                                                        VMULFF    50
 9000 CONTINUE                                                          VMULFF    51
      CALL UERTST (IER,6HVMULFF)                                        VMULFF    52
 9005 RETURN                                                            VMULFF    53
      END
```



82500

```
1                SUBROUTINE PLT20(X,Y,JT,KI,IYMAX,XL,XS,YL,YS)                    PLT20    2
           C     THIS PROGRAM PLOTS X IN A 0-100 FIELD VS. Y IN A 0-IYMAX FIELD.  PLT20    3
           C     X AND Y VALUES ARE ROUNDED (NOT TRUNCATED) TO NEAREST INTEGERS.  PLT20    4
           C     ACTUAL VALUES OF X AND Y ARE PRINTED ON ABSCISSA AND ORDINATE.   PLT20    5
5          C     Y VALUES ARE PRINTED IN DESCENDING OR ASCENDING ORDER FOR IYMAX   PLT20    6
           C     LESS THAN OR GREATER THAN 60.                                    PLT20    7
           C     PLT20 MODIFIED 3-18-70 BY C.PATRICK TO ALLOW AN UNLIMITED        PLT20    8
           C     NUMBER OF POINTS TO BE PLOTTED.  THE PREVIOUS RESTRICTION WAS    PLT20    9
           C     500 X-Y POINTS ON THE PLOT.  THIS MOD WILL INCREASE THE EXECUTION PLT20   10
10         C     TIME BUT SAVES 1000 DECIMAL WORDS OF PROGRAM STORAGE.            PLT20    11
                 DIMENSION X(2),Y(2),IFX(101),ZX(11)                              PLT20    12
                 XSCALE=(XL-XS)*.01                                               PLT20    13
                 YSCALE=(YL-YS)/FLOAT(IYMAX)                                      PLT20    14
                 PRINT 180                                                        PLT20    15
15               PRINT 190                                                        PLT20    16
                 IF (IYMAX-60)60,60,80                                            PLT20    17
              60 LL=IYMAX                                                         PLT20    18
                 GO TO 100                                                        PLT20    19
              70 LL=LL-1                                                          PLT20    20
20               GO TO 100                                                        PLT20    21
              80 LL=0                                                             PLT20    22
                 GO TO 100                                                        PLT20    23
              90 LL=LL+1                                                          PLT20    24
                 GO TO 100                                                        PLT20    25
25           100 DO 110 I=1,101                                                   PLT20    26
             110 IFX(I)=1H                                                        PLT20    27
                 IF (J1.GT.KI) GO TO 51                                           PLT20    28
                 DO 50 I=J1,KI                                                    PLT20    29
                 IF (XL-X(I)) 50,10,10                                            PLT20    30
30           10  IF (X(I)-XS) 50,20,20                                           PLT20    31
             20  IF (YL-Y(I)) 50,30,30                                           PLT20    32
             30  IF (Y(I)-YS) 50,40,40                                           PLT20    33
             40  IX=(X(I)-XS)/XSCALE+0.5                                         PLT20    34
                 IY=(Y(I)-YS)/YSCALE+0.5                                          PLT20    35
35               IF (IY-LL) 50,120,50                                             PLT20    36
            120  II=IX+1                                                          PLT20    37
                 IFX(II)=1H*                                                      PLT20    38
             50  CONTINUE                                                         PLT20    39
             51  CONTINUE                                                         PLT20    40
40               ZY=FLOAT(LL)*YSCALE+YS                                           PLT20    41
                 PRINT 200,ZY,(IFX(I),I=1,101)                                    PLT20    42
                 IF (IYMAX-60)140,140,150                                         PLT20    43
            140  IF (LL)160,160,70                                                PLT20    44
            150  IF (LL-IYMAX)90,160,160                                          PLT20    45
45          160  PRINT 190                                                        PLT20    46
                 DO 170 K=1,11                                                    PLT20    47
            170  ZX(K)=10.*FLOAT(K-1)*XSCALE+XS                                   PLT20    48
                 PRINT 210,(ZX(K),K=1,11)                                         PLT20    49
                 PRINT 220,YSCALE                                                 PLT20    50
50               PRINT 230,XSCALE                                                 PLT20    51
           C                                                                      PLT20    52
                 RETURN                                                           PLT20    53
           C                                                                      PLT20    54
            180  FORMAT (1H1)                                                     PLT20    55
55          190  FORMAT (11H  Y VALUES.,22(5H....I))                              PLT20    56
            200  FORMAT (1H ,F8.3,5X,1HI,101A1,1HI)                               PLT20    57
            210  FORMAT (2H  ,2HX=,5X,11(2X,F8.3))                                PLT20    58
```

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62500

```
      220 FORMAT (11H  Y SCALE =,F8.3,11H UNITS/LINE)                    PLT20     59
      230 FORMAT (11H  X SCALE =,F8.3,16H UNITS/PRINT BAR)               PLT20     60
60        END                                                            PLT20     61
```



625 00

```
      SUBROUTINE XRANGE (X,JI,KI,XL,XS)                                  XRANGE     2
      DIMENSION X(2)                                                     XRANGE     3
      ENTRY YRANGE                                                       XRANGE     4
      XL=-2.0E56                                                         XRANGE     5
      XS=2.0E56                                                          XRANGE     6
      IF (JI.GT.KI) GO TO 11                                             XRANGE     7
      DO 10 I=JI,KI                                                      XRANGE     8
      XL=AMAX1(XL,X(I))                                                  XRANGE     9
   10 XS=AMIN1(XS,X(I))                                                  XRANGE    10
   11 RETURN                                                            XRANGE    11
      C  MODIFIED BY C.PATRICK ON 3-18-70 TO COMBINE XRANGE AND YRANGE   XRANGE    12
      END                                                                XRANGE    13
```



62500

```
      SUBROUTINE WRITO(LUN,RNAME,NSIZE,INDEX)                          WRITO       2
      COMMON/SYMSOL/NN,MM,NNPE,NDOF,NVECT,NODES,NELEM,NW,LUT,LUK,LUE,  WRITO       3
     +LUR,INDEX3(41),INDEX7(146),INDEX17(821),INDEX19(41),KRECRD(820), WRITO       4
     +NEQ                                                              WRITO       5
      KBEFOR=1                                                         WRITO       6
      GO TO(100,100,3,100,100,100,100,100,100,100,100,100,100,100,100, WRITO       7
     +100,17),LUN                                                      WRITO       8
  100 WRITE(61,900)LUN                                                 WRITO       9
  900 FORMAT(1H0,*ERROR....TRIED TO WRITE ON TAPE*,I3,*  WHICH DOES NOT* WRITO      10
     +**EXIST*)                                                        WRITO      11
      CALL EXIT                                                        WRITO      12
    3 CONTINUE                                                         WRITO      13
      KBEFOR=1                                                         WRITO      14
      ITEST=INDEX3(INDEX+1)                                            WRITO      15
      IF(ITEST.EQ.0)KBEFOR=0                                           WRITO      16
      CALL WRITMS(LUN,RNAME,NSIZE,INDEX,KBEFOR)                        WRITO      17
      GO TO 1000                                                       WRITO      18
   17 CONTINUE                                                         WRITO      19
      KBEFOR=1                                                         WRITO      20
$*ID DH8/24                                                            WRITO      21
      ITEST=INDEX17(INDEX+1)                                           WRITO      22
      IF(ITEST.EQ.0)KBEFOR=0                                           WRITO      23
      CALL WRITMS(LUN,RNAME,NSIZE,INDEX,KBEFOR)                        WRITO      24
 1000 CONTINUE                                                         WRITO      25
      RETURN                                                           WRITO      26
      END                                                              WRITO      27
```



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```
      SUBROUTINE READLUR(LUR,B,NS,NR,IZOT)                          READLUR    2
       INTEGER B(2)                                                 READLUR    3
      COMMON /BILL/LURA(1478),IREAD,IWRITE                          READLUR    4
      INDEX= NS*NR-NS                                               READLUR    5
      DO 1 I=1,NS                                                   READLUR    6
      B(I) = LURA(INDEX+I)                                          READLUR    7
    1 CONTINUE                                                      READLUR    8
      IREAD=IREAD+1                                                 READLUR    9
      RETURN                                                        READLUR   10
      ENTRY WRITLUR                                                 READLUR   11
      INDEX=NS*NR-NS                                                READLUR   12
      DO 2 I=1,NS                                                   READLUR   13
      LURA(INDEX+I)= B(I)                                           READLUR   14
    2 CONTINUE                                                      READLUR   15
      IWRITE=IWRITE+1                                               READLUR   16
      RETURN                                                        READLUR   17
      END                                                           READLUR   18
```



62500

```
      SUBROUTINE MATPRT(MD,ND,M,N,A)                                    MATPRT     2
C     PRINTS AN M BY N MATRIX 10 COLUMNS PER PAGE                       MATPRT     3
      DIMENSION A(MD,ND)                                                MATPRT     4
      INTEGER RTCOL                                                     MATPRT     5
      NPAGES=(N-1)/10+1                                                 MATPRT     6
      DO 20 I=1,NPAGES                                                  MATPRT     7
      LTCOL=10*(I-1)+1                                                  MATPRT     8
      RTCOL=10*1                                                        MATPRT     9
      IF (RTCOL.LE.N)GO TO 10                                           MATPRT    10
      RTCOL=N                                                           MATPRT    11
   10 CONTINUE                                                          MATPRT    12
      WRITE (61,30)(J,J=LTCOL,RTCOL)                                    MATPRT    13
      DO 20 J=1,M                                                       MATPRT    14
   20 WRITE (61,40)J,(A(J,K),K=LTCOL,RTCOL)                             MATPRT    15
      RETURN                                                            MATPRT    16
C                                                                       MATPRT    17
C                                                                       MATPRT    18
   30 FORMAT (1H ,I14,9I12/)                                            MATPRT    19
   40 FORMAT (1H ,I3,10E12.4)                                           MATPRT    20
      END                                                               MATPRT    21
```



625 00

```
      SUBROUTINE PACK60 (J,N,I)                                          PACK60   2
C     ENTRY POINTS PACK60 AND UNPCK60                                    PACK60   3
C                                                                        PACK60   4
      DIMENSION LAB(2), MASKS(2)                                         PACK60   5
      DATA LAB / 6HPACK60 , 7HUNPCK60  /                                 PACK60   6
      DATA MASKS(1) / 777777777777777776B  /                             PACK60   7
      DATA MASKS(2) / 000000000000000001B  /                             PACK60   8
C                                                                        PACK60   9
C     STORE N INTO J IN THE I(TH) POSITION                               PACK60  10
C     N= 0  OR  N=1  OR N=-0                                             PACK60  11
C     MINUS ZERO IS TREATED AS PLUS ZERO                                 PACK60  12
C          0 .LT. I .LT. 61                                              PACK60  13
C     EACH POSITION IN J FOR THE INTEGER N IS ONE BIT                    PACK60  14
C     POSITION 1 IS THE HIGH ORDER BIT (BIT 59)                          PACK60  15
C     POSITION 60 IS THE LOW ORDER BIT (BIT 0)                           PACK60  16
C                                                                        PACK60  17
      K= 1                                                               PACK60  18
      IF (N .NE. 0 .AND. N .NE. 1) GO TO 50                              PACK60  19
   10 IF (I .GT. 0 .AND . I .LE. 60) GO TO 100                           PACK60  20
   50 PRINT 1000, LAB(K), J, N, I                                        PACK60  21
      CALL EXIT                                                          PACK60  22
C     SHIFT J  SO BIT IS IN LOW ORDER POSITION                           PACK60  23
  100 L= SHIFT ( J , I )                                                 PACK60  24
C     USE MASK TO ZERO THE BIT (PACK)                                    PACK60  25
C     USE MASK TO ZERO THE OTHER 59 BITS (UNPACK)                        PACK60  26
      L= AND (L, MASKS(K) )                                              PACK60  27
      IF (K .EQ. 2) GO TO 200                                            PACK60  28
C     CHECK FOR MINUS ZERO                                               PACK60  29
      M= N                                                               PACK60  30
      IF (N .EQ. 0) M= 0                                                 PACK60  31
C     STORE N INTO WORD AND SHIFT BACK INTO PROPER POSITION FOR J        PACK60  32
      J= SHIFT ( L+M , 60 - I )                                          PACK60  33
      RETURN                                                             PACK60  34
C                                                                        PACK60  35
C                                                                        PACK60  36
      ENTRY UNPCK60                                                      PACK60  37
C                                                                        PACK60  38
C                                                                        PACK60  39
C     UNPACK N FROM WORD J, I(TH) POSITION                               PACK60  40
C     SEE COMMENTS ABOVE                                                 PACK60  41
      K= 2                                                               PACK60  42
      GO TO 10                                                           PACK60  43
  200 N= L                                                               PACK60  44
      RETURN                                                             PACK60  45
C                                                                        PACK60  46
 1000 FORMAT (13H0BAD CALL TO   ,A7, 15H, ARGS(OCTAL)=   3030 )          PACK60  47
      END                                                                PACK60  48
```



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      OVERLAY(ISOFP1,1,0)                                                MAIN1      2
      PROGRAM MAIN1                                                      MAIN1      3
      COMMON /IZO/ IN,IOUT                                               MAIN1      4
      COMMON/SYMSOL/NN,MM,NNPE,NDOF,NVECT,NODES,NELEM,NW,LUT,LUK,LUE,    MAIN1      5
     +LUM,INDEX3(41),INDEX7(146),INDEX17(821),INDEX19(41),KRECPD(820),   MAIN1      6
     +NEQ                                                                MAIN1      7
      COMMON/CURRM2/TITLE(8),ICM(30),FNOA(160),NB(145,2),SM(3,3),SMT(3,3 MAIN1      8
     +),SMS(6,6),S(6,6)                                                  MAIN1      9
      COMMON /NSX/ NS                                                    MAIN1     10
      COMMON /FOILEY/ IFOIL,NODFL                                        MAIN1     11
      COMMON/L/AL,TC                                                     MAIN1     12
      COMMON/RT/RK,RB,R0,T,REF,RL                                        MAIN1     13
      DIMENSION TRAE(9),TRRE(9)                                          MAIN1     14
      DIMENSION IRC(3)                                                   MAIN1     15
      DIMENSION FALPHA(11)                                               MAIN1     16
      DIMENSION FORCE(3)                                                 MAIN1     17
      EQUIVALENCE (TRAE(1),SM(1,1)),(TRRE(1),SMT(1,1))                   MAIN1     18
      DATA IN/60/,IOUT/61/                                               MAIN1     19
      NDOF=3                                                             MAIN1     20
      NNPE=2                                                             MAIN1     21
      RK=RB                                                              MAIN1     22
      R=RK                                                               MAIN1     23
      READ(60,R)YM                                                       MAIN1     24
      THETA=(PL/RK)*180./3.14159                                         MAIN1     25
      IEND=0                                                             MAIN1     26
      IFOR=0                                                             MAIN1     27
      IDEL=0                                                             MAIN1     28
      NODES=IFOIL*NODFL                                                  MAIN1     29
      NODFL2=NODFL/2                                                     MAIN1     30
      I1=NODFL2-1                                                        MAIN1     31
      M=NODFL/2                                                          MAIN1     32
      FOIL=IFOIL                                                         MAIN1     33
      ALPHA=360./FOIL                                                    MAIN1     34
      IF(ALPHA.LT.2.*THETA)GO TO 10                                      MAIN1     35
      WRITE(61,9)                                                        MAIN1     36
    9 FORMAT(1H0,5(1H*),*  ERROR, FOIL LENGTH CAUSES 3 FOIL OVERLAP*)    MAIN1     37
      CALL EXIT                                                          MAIN1     38
   10 CONTINUE                                                           MAIN1     39
      PHI=THETA-ALPHA                                                    MAIN1     40
      ANGLE=PHI/(M-1)                                                    MAIN1     41
      WRITE(IOUT,600)                                                    MAIN1     42
      IBASE=1                                                            MAIN1     43
      NFOIL=1                                                            MAIN1     44
      NVECT=1                                                            MAIN1     45
      NS=12.                                                             MAIN1     46
      NODES=IFOIL*NODFL                                                  MAIN1     47
      NW=NODES-1                                                         MAIN1     48
      NEQ=NODES*NDOF                                                     MAIN1     49
      NN=(NEQ+NS-1)/NS                                                   MAIN1     50
      NBAND=(NK+1)*NDOF                                                  MAIN1     51
      MM=(NBAND-NDOF-1)/NS+2                                             MAIN1     52
      ME=NODFL*3*IFOIL                                                   MAIN1     53
      NELEM=(NODFL-1)*IFOIL                                              MAIN1     54
      JNODE=NODFL-1                                                      MAIN1     55
      FS=YM*AL*T**3/12.                                                  MAIN1     56
      T=T+TC                                                             MAIN1     57
      IF(YM.LT.1.0E06) FS=FS*1.0E06                                      MAIN1     58
```



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      IF(YM.LT.1.0E06)YM=YM*1.0E06                                          MAIN1   59
      WRITE(61,7)YM,FS                                                      MAIN1   60
    7 FORMAT(1H0,*MODULUS OF ELASTICITY = *,E15.5,/,1X,*EI FOR FOIL= *,     MAIN1   61
     +E15.5)                                                                MAIN1   62
        FOIL=IFOIL                                                          MAIN1   63
      JNOD=NODFL                                                            MAIN1   64
      N=0                                                                   MAIN1   65
      FALPHA(IFOIL+1)=360                                                   MAIN1   66
      DO 14 I=1,IFOIL                                                       MAIN1   67
      FALPHA(I)=(I-1)*ALPHA                                                 MAIN1   68
   14 CONTINUE                                                              MAIN1   69
      DO 15 I=1,IFOIL                                                       MAIN1   70
      N1=N+1                                                                MAIN1   71
      DO 17 J=N1,JNOD                                                       MAIN1   72
      FNOA(J)=(J-(I-1)*NODFL-1)*ANGLE+FALPHA(I)                             MAIN1   73
      IF(J.GE.NODFL*(I-1)+M+1)FNOA(J)=(J-NODFL*(I-1)-M-1)*ANGLE+FALPHA(I    MAIN1   74
     ++1)                                                                   MAIN1   75
      IF(J.EQ.JNOD)N=J                                                      MAIN1   76
   17 CONTINUE                                                              MAIN1   77
      JNOD=NODFL*(I+1)                                                      MAIN1   78
   18 IONE=1+(I-1)*NODFL                                                    MAIN1   79
      INN=1*NODFL                                                           MAIN1   80
      FI=1                                                                  MAIN1   81
      DO 40 J=IONE,INN                                                      MAIN1   82
      FNOA(J)=FNOA(J)*3.14159/180.0                                         MAIN1   83
   40 CONTINUE                                                              MAIN1   84
   15 CONTINUE                                                              MAIN1   85
      DO 1000 I=1,IFOIL                                                     MAIN1   86
      DO 1000 JP=1,JNODE                                                    MAIN1   87
      J=JP+(I-1)*NODFL                                                      MAIN1   88
      BETA=FNOA(J+1)-FNOA(J)                                                MAIN1   89
      SB=SIN(BETA)                                                          MAIN1   90
      CB=COS(BETA)                                                          MAIN1   91
      SB2=2.*SB*CB                                                          MAIN1   92
      AT=BETA-SB                                                            MAIN1   93
      BT=CB+SB*SB/2.-1.                                                     MAIN1   94
      CT=1.5*BETA-2.*SB+SB2/4.                                              MAIN1   95
      DT=BETA/2.-SB2/4.                                                     MAIN1   96
      ET=CB-1.                                                              MAIN1   97
      A=ET*ET/BETA-DT                                                       MAIN1   98
      B=BT-AT*ET/BETA                                                       MAIN1   99
      C=AT*DT-BT*ET                                                         MAIN1  100
      D=AT*AT/BETA-CT                                                       MAIN1  101
      E=CT*ET-AT*BT                                                         MAIN1  102
      F=BT*BT-CT*DT                                                         MAIN1  103
      G=BT*(BT-2.*AT*ET/BETA)+CT*(ET*ET/BETA-DT)+AT*AT*DT/BETA              MAIN1  104
      GR3=G*R**3                                                            MAIN1  105
      SM(1,1)=A/GR3*FS                                                      MAIN1  106
      SM(1,2)=B/GR3*FS                                                      MAIN1  107
      SM(1,3)=C*R/BETA/GR3*FS                                               MAIN1  108
      SM(2,1)=SM(1,2)                                                       MAIN1  109
      SM(2,2)=D/GR3*FS                                                      MAIN1  110
      SM(2,3)=E*R/BETA/GR3*FS                                               MAIN1  111
      SM(3,1)=SM(1,3)                                                       MAIN1  112
      SM(3,2)=SM(2,3)                                                       MAIN1  113
      SM(3,3)=F*R**2/BETA/GR3*FS                                            MAIN1  114
      DO 110 II=1,3                                                         MAIN1  115
```



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115                DO 110 JJ=1,3                                          MAIN1  116
               110 SMS(II,JJ)=SM(II,JJ)                                   MAIN1  117
                   SM(1,2)=-SM(1,2)                                       MAIN1  118
                   SM(2,1)=-SM(2,1)                                       MAIN1  119
                   SM(2,3)=-SM(2,3)                                       MAIN1  120
120                SM(3,2)=-SM(3,2)                                       MAIN1  121
                   DO 120 II=1,3                                          MAIN1  122
                   DO 120 JJ=1,3                                          MAIN1  123
               120 SMS(II+3,JJ+3)=SM(II,JJ)                               MAIN1  124
                   SM(1,1)=(-A*CB-B*SB)/GR3*FS                            MAIN1  125
125                SM(1,2)=(-B*CB-D*SB)/GR3*FS                            MAIN1  126
                   SM(1,3)=(-C*CB-E*SB)*R/BETA/GR3*FS                     MAIN1  127
                   SM(2,1)=(A*SB-B*CB)/GR3*FS                             MAIN1  128
                   SM(2,2)=(B*SB-D*CB)/GR3*FS                             MAIN1  129
                   SM(2,3)=(C*SB-E*CB)*R/BETA/GR3*FS                      MAIN1  130
130                SM(3,1)=(A*(CB-1.)+B*SB-C/BETA)*R/GR3*FS               MAIN1  131
                   SM(3,2)=(B*(CB-1.)+D*SB-E/BETA)*R/GR3*FS               MAIN1  132
                   SM(3,3)=(C*(CB-1.)+E*SB-F)*R*R/BETA/GR3*FS             MAIN1  133
                     DO 130 II=1,3                                        MAIN1  134
                   DO 130 JJ=1,3                                          MAIN1  135
135            130 SMS(II+3,JJ)=SM(II,JJ)                                 MAIN1  136
                   CALL GMTRA(TRAE,TRRE,3,3)                              MAIN1  137
                   DO 140 II=1,3                                          MAIN1  138
                   DO 140 JJ=1,3                                          MAIN1  139
               140 SMS(II,JJ+3)=SMT(II,JJ)                                MAIN1  140
140                JR=JR+(I-1)*JNODE                                      MAIN1  141
                   DO 300 JJ=1,2                                          MAIN1  142
                   IBASE=IBASE+(JJ-1)                                     MAIN1  143
                   NB(JR,JJ)=IBASE                                        MAIN1  144
               300 CONTINUE                                               MAIN1  145
145                IF(((NFOIL*NCUFL)-1).NE.J) GO TO 350                   MAIN1  146
                   IBASE=IBASE+1                                          MAIN1  147
                   NFOIL=NFOIL+1                                          MAIN1  148
               350 CONTINUE                                               MAIN1  149
                   CALL WRITMS(LUE,SMS,36,JR)                             MAIN1  150
150                  1 FORMAT(8A10)                                       MAIN1  151
                     3 FORMAT(16I5)                                       MAIN1  152
                     4 FORMAT(1X,16I5)                                    MAIN1  153
                     5 FORMAT(4I5,4F10.4,3I5)                             MAIN1  154
                     6 FORMAT(1X,8E12.4)                                  MAIN1  155
155                  8 FORMAT(F10.0)                                      MAIN1  156
                    80 FORMAT(1H1)                                        MAIN1  157
                    81 FORMAT(20X,8A10,/)                                 MAIN1  158
                   410 FORMAT(2I5,3F10.4)                                 MAIN1  159
                   600 FORMAT(1X,9E12.3,/)                                MAIN1  160
160                610 FORMAT(1X,18E7.1)                                  MAIN1  161
                  1000 CONTINUE                                           MAIN1  162
                C                                                         MAIN1  163
                     END                                                  MAIN1  164
```



0 0 2 5 0 0

```
      SUBROUTINE GMTRA (A,R,N,M)                                    MAIN1   165
      DIMENSION A(1),R(1)                                           MAIN1   166
      IR=0                                                          MAIN1   167
      DO 10 I=1,N                                                   MAIN1   168
      IJ=I-N                                                        MAIN1   169
      DO 10 J=1,M                                                   MAIN1   170
      IJ=IJ+N                                                       MAIN1   171
      IR=IR+1                                                       MAIN1   172
   10 R(IR)=A(IJ)                                                   MAIN1   173
      RETURN                                                        MAIN1   174
      END                                                           MAIN1   175
```



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```
      OVERLAY(ISOFB1,6,0)                                                    PRELOD     2
      PROGRAM PRELOD                                                         PRELOD     3
      COMMON/FOILLY/IFOIL,NODFL                                              PRELOD     4
      COMMON/RT/RSI,RB,RS,T,RFF,RL                                           PRELOD     5
      COMMON/LOD/F(480,1),JDISP(30),S(6,6),RK(30,30),UR(160),U(480),NUT(     PRELOD     6
     +30)                                                                    PRELOD     7
     +,NFT(30),UB(11,1),AAK(30,30),ABK(30,11),BAK(11,30),BBK(11,11)          PRELOD     8
     +,C(11,30),F1(11,11),UT(30,11),UA(30,1),F2(11,1)                        PRELOD     9
      COMMON/CURRMZ/TITLE(8),ICM(30),FNOA(10)                                PRELOD    10
      COMMON/NSX/NS                                                          PRELOD    11
      COMMON/PDEL/R(160),RF(162),PSP(160),URASS(10),RASS(10)                 PRELOD    12
      COMMON/ITER/ITERATE                                                    PRELOD    13
      COMMON/FOR/FORCES(160)                                                 PRELOD    14
      COMMON/PDDISP/NDDISP,I1DDSP(160),I2DDSP(160),DDISPY(160),DDISPX(16     PRELOD    15
     +0)                                                                     PRELOD    16
      COMMON/BCP/KODEBC(160),FDZ(160),FDR(160)                               PRELOD    17
      COMMON/SYMSOL/NN,MM,NNPE,NDOF,NVECT,NODES,NELEM,NW,LUT,LUK,LUE,        PRELOD    18
     +LUR,INDEX3(41),INDEX7(146),INDEX17(821),INDEX19(41),KRECRD(820),       PRELOD    19
     +NEQ                                                                    PRELOD    20
      COMMON/SET/NODSET(160),NNODST                                          PRELOD    21
      COMMON/PLOTQ/IPLOT,NPLOT,IPRINT,MPRINT                                 PRELOD    22
      COMMON/EC/EC,PSI                                                       PRELOD    23
      COMMON/ECC/THETA(160)                                                  PRELOD    24
      DIMENSION RP(1)                                                        PRELOD    25
      DIMENSION B(3,160)                                                     PRELOD    26
      DIMENSION PRE(160)                                                     PRELOD    27
      DIMENSION FB(11,1)                                                     PRELOD    28
      EQUIVALENCE (B(1,1),F(1,1))                                            PRELOD    29
      CALL MEMSET(F(1,1),U(480),0.)                                          PRELOD    30
      IF(ITERATE.NE.0)READ(15)(RK(I),I=1,900)                                PRELOD    31
      IF(ITERATE.NE.0)RFINAL=0.                                              PRELOD    32
      IF(ITERATE.NE.0)IEC=1                                                  PRELOD    33
      CALL MEMSET(NODSET(1),NODSET(160),0)                                   PRELOD    34
      IF(ITERATE.NE.0)GO TO 1000                                             PRELOD    35
      CALL MEMSET(PRE(1),PRE(160),0.)                                        PRELOD    36
      CALL MEMSET(F(1,1),F2(11,1),0.)                                        PRELOD    37
      CALL MEMSET(FDZ(1),FDR(160),0.)                                        PRELOD    38
      CALL MEMSET(KODEBC(1),KODEBC(160),0)                                   PRELOD    39
      CALL MEMSET(NDDISP,I2DDSP(160),0)                                      PRELOD    40
      CALL MEMSET(DDISPY(1),DDISPX(160),0.)                                  PRELOD    41
      CALL MEMSET(KRECRD(1),KRECRD(820),0)                                   PRELOD    42
      CALL MEMSET(FORCES(1),FORCES(160),0.)                                  PRELOD    43
      LUR=19                                                                 PRELOD    44
      LUK=17                                                                 PRELOD    45
      CALL OPENMS(LUK,INDEX17,821,0)                                         PRELOD    46
      IK=NDOF*NODFL-NSD                                                      PRELOD    47
      NODFL2=NODFL/2                                                         PRELOD    48
      NDFF=NDOF*NODFL                                                        PRELOD    49
      IBASE=1                                                                PRELOD    50
      NFOIL=1                                                                PRELOD    51
C     JDISP(1)=1                                                             PRELOD    52
C     DO 50 I=2,NDFF,3                                                       PRELOD    53
C 50    JDISP(I)=1                                                           PRELOD    54
C ASSEMBLE K MATRIX FOR FOIL                                                 PRELOD    55
      NELEMF=NODFL-1                                                         PRELOD    56
      DO 100 K=1,NELEMF                                                      PRELOD    57
      CALL READMS(LUE,S,36,K)                                                PRELOD    58
```

```
      HED=1H                                                                PRELOD     59
      IF(IPRINT.NE.2)GO TO 95                                               PRELOD     60
60    WRITE(61,103)HED                                                      PRELOD     61
      DO 98 NJ=1,6                                                          PRELOD     62
      WRITE(61,99)(S(NJ,JN),JN=1,6)                                         PRELOD     63
98    CONTINUE                                                              PRELOD     64
99    FORMAT(1H0,6(1X,E11.5))                                               PRELOD     65
65    95 CONTINUE                                                           PRELOD     66
      I=(K-1)*NDOF+1                                                        PRELOD     67
      J1=(K-1)*NDOF+1                                                       PRELOD     68
      J2=(K-1)*NDOF+NNPE*NDOF                                               PRELOD     69
      DO 100 I=J1,J2                                                        PRELOD     70
70    DO 100 J=J1,J2                                                        PRELOD     71
      M=J-(K-1)*NDOF                                                        PRELOD     72
      L=I-(K-1)*NDOF                                                        PRELOD     73
100   RK(I,J)=RK(I,J)+S(L,M)                                                PRELOD     74
C     WRITE(61,103)                                                         PRELOD     75
75    103 FORMAT(1H0,A6,//)                                                 PRELOD     76
C     DO 102 JJ=1,NDFF                                                      PRELOD     77
C   WRITE(61,101)(RK(JJ,II),II=1,NDFF)                                      PRELOD     78
102   CONTINUE                                                              PRELOD     79
101   FORMAT(1H ,11(1X,E11.5))                                              PRELOD     80
80    C CALCULATE SPECIFIED DISPLACEMENTS                                   PRELOD     81
C       CHECKFOR 0 LOAD POSITION ON FIRST PASS                              PRELOD     82
      RNOT=RFF                                                              PRELOD     83
  10  6 CONTINUE                                                            PRELOD     84
      IPASS=1                                                               PRELOD     85
85    CALL FGEO(SA,R2,RNOT,IPASS)                                           PRELOD     86
      IF(IPASS.EQ.3)GO TO 105                                               PRELOD     87
      IF(IPASS.EQ.3)GO TO 105                                               PRELOD     88
      CALL EXIT                                                             PRELOD     89
105   CONTINUE                                                              PRELOD     90
90    IF(IPRINT.NE.0)WRITE(61,104)SA,R2                                     PRELOD     91
104   FORMAT(1H0,*SA=*,E11.5,2X,*R2=*,E11.5)                                PRELOD     92
      RFOIL=IFOIL                                                           PRELOD     93
C RADIUS CALCULATIONS                                                       PRELOD     94
      IF(IPRINT.NE.0)WRITE(61,112)                                          PRELOD     95
95    DO 110 I=1,NODFL                                                      PRELOD     96
      SL=ENDA(I)*RS1                                                        PRELOD     97
      ALPHA=SL/RFF                                                          PRELOD     98
      R(I)=SQRT(RFF**2+(RFF-(RB-T))**2-2.*RFF*(RFF-(RB-T))*COS(ALPHA))      PRELOD     99
      RASS(I)=R(I)                                                          PRELOD    100
100   IF(IPRINT.EQ.0)GO TO 110                                              PRELOD    101
      WRITE(6,111)I,R(I),SL,ALPHA                                           PRELOD    102
  110 CONTINUE                                                              PRELOD    103
111   FORMAT(1H ,*R(*,I2*)= *,E11.5,2E15.5)                                 PRELOD    104
112   FORMAT(1H0,*INITIAL RADIUS*,6X,*ARCLENGTH*,6X,*ANGLE*)                PRELOD    105
105   C     CALCULATE DISP. FOR ASSEM.POSITION                              PRELOD    106
      UR(1)=0.                                                              PRELOD    107
      UR(NODFL2)=R(NODFL2)-(R2+T)                                           PRELOD    108
      UR(NODFL)=R(NODFL)-R2                                                 PRELOD    109
      JDISP(1)=1                                                            PRELOD    110
110   JDISP(2)=1                                                            PRELOD    111
      JDISP(NODFL2*NDOF-1)=1                                                PRELOD    112
      JDISP(NODFL*NDOF-1)=1                                                 PRELOD    113
      NSO=4                                                                 PRELOD    114
      J=1                                                                   PRELOD    115
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      DO 250 I=2,NDFF,3                                                  PRELOD  116
      U(I)=UR(J)                                                         PRELOD  117
250   J=J+1                                                              PRELOD  118
      L=1                                                                PRELOD  119
      J=1                                                                PRELOD  120
      K=NDOF*NODFL-NSD+1                                                 PRELOD  121
      DO 260 I=1,NDFF                                                    PRELOD  122
      IF(JDISP(I).EQ.1)GO TO 255                                         PRELOD  123
      NUT(J)=I                                                           PRELOD  124
      NFT(J)=I                                                           PRELOD  125
      J=J+1                                                              PRELOD  126
      GO TO 260                                                          PRELOD  127
255   NFT(K)=I                                                           PRELOD  128
      NUT(K)=I                                                           PRELOD  129
      UB(L)=U(I)                                                         PRELOD  130
      K=K+1                                                              PRELOD  131
      L=L+1                                                              PRELOD  132
260   CONTINUE                                                           PRELOD  133
      IF(IPRINT.EQ.0)GO TO 264                                           PRELOD  134
      DO 262 I=1,30                                                      PRELOD  135
262   WRITE(61,261)I,NFT(I),I,NUT(I)                                     PRELOD  136
261   FORMAT(1H ,*NFT(*,I3,*)=*,I3,5X,*NUT(*,I3,*)=*,I3)                 PRELOD  137
      WRITE(61,263)(UB(I),I=1,11)                                        PRELOD  138
 264  CONTINUE                                                           PRELOD  139
263   FORMAT(1H0,11(1X,F8.4))                                            PRELOD  140
      IK=NDOF*NODFL-NSD                                                  PRELOD  141
      IK1=IK+1                                                           PRELOD  142
C TRANSFORM K TO K PRIME                                                 PRELOD  143
C ASSEMBLE K ALPHA ALPHA                                                 PRELOD  144
      DO 300 I=1,IK                                                      PRELOD  145
      DO 300 J=1,IK                                                      PRELOD  146
      RKAAK=RK(NFT(I),NUT(J))                                            PRELOD  147
      ARK=ABS(RKAAK)                                                     PRELOD  148
      IF(ARK.GT.0..AND.ARK.LT.1.)RKAAK=0.                                PRELOD  149
300   AAK(I,J)=RKAAK                                                     PRELOD  150
C ASSEMBLE K A,B                                                         PRELOD  151
      NSD1=NSD+1                                                         PRELOD  152
      K=1                                                                PRELOD  153
      DO 310 I=1,IK                                                      PRELOD  154
      K=1                                                                PRELOD  155
      DO 310 J=IK1,NDFF                                                  PRELOD  156
      ABK(I,K)=RK(NFT(I),NUT(J))                                         PRELOD  157
310   K=J-IK+1                                                           PRELOD  158
C ASSEMBLE K B,A                                                         PRELOD  159
      K=1                                                                PRELOD  160
      DO 320 I=IK1,NDFF                                                  PRELOD  161
      DO 319 J=1,IK                                                      PRELOD  162
319   BAK(K,J)=RK(NFT(I),NUT(J))                                         PRELOD  163
320   K=K+1                                                              PRELOD  164
321   FORMAT(1H0,11(1X,E10.4))                                           PRELOD  165
C ASSEMBLE KBB                                                           PRELOD  166
      K=1                                                                PRELOD  167
      L=1                                                                PRELOD  168
      DO 335 I=IK1,NDFF                                                  PRELOD  169
      L=1                                                                PRELOD  170
      DO 330 J=IK1,NDFF                                                  PRELOD  171
      BBK(K,L)=RK(NFT(I),NUT(J))                                         PRELOD  172
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                330   L=J-IK+1                                                  PRELOD  173
                335   K=K+1                                                     PRELOD  174
                336   FORMAT(1H0,10(1X,E10.4))                                  PRELOD  175
      175       C     WRITE(61,999)IPOSN,IK                                     PRELOD  176
                      D1=1.                                                     PRELOD  177
                      D2=1.                                                     PRELOD  178
                      HED=3HAAK                                                 PRELOD  179
                C     WRITE(61,103)HED                                          PRELOD  180
      180       C     DO 340KI=1,IK                                             PRELOD  181
                C340   WRITE(61,101)(AAK(KI,JI),JI=1,IK)                       PRELOD  182
                      IDGT=5                                                    PRELOD  183
                C     WRITE(61,339)IDGT                                         PRELOD  184
                339   FORMAT(1H0,*IDGT=*,I3)                                    PRELOD  185
      185             CALL INVERT(AAK,IK,30,NERR)                               PRELOD  186
                      HED=6HAAKINV                                              PRELOD  187
                C     WRITE(61,103)HED                                          PRELOD  188
                C     DO 341 KI=1,IK                                            PRELOD  189
                C341   WRITE(61,101)(AAK(KI,JI),JI=1,IK)                       PRELOD  190
      190             HED=3HABK                                                 PRELOD  191
                C     WRITE(61,103)HED                                          PRELOD  192
                C     DO 342 KI=1,IK                                            PRELOD  193
                C342   WRITE(61,101)(ABK(KI,IJ),IJ=1,NSD)                       PRELOD  194
                      HED=3HBAK                                                 PRELOD  195
      195       C     WRITE(61,103)HED                                          PRELOD  196
                C     DO 343 KI=1,NSD                                           PRELOD  197
                C343   WRITE(61,101)(BAK(KI,IJ),IJ=1,IK)                       PRELOD  198
                      HED=3HBBK                                                 PRELOD  199
                C     WRITE(61,103)HED                                          PRELOD  200
      200       C     DO 344 KI=1,NSD                                           PRELOD  201
                C344   WRITE(61,101)(BBK(KI,IJ),IJ=1,NSD)                       PRELOD  202
                      CALL VMULFF(BAK,AAK,NSD,IK,IK,11,30,C,11,IER)             PRELOD  203
                      HED=1HC                                                   PRELOD  204
                C     WRITE(61,103)HED                                          PRELOD  205
      205       C     DO 345 KI=1,NSD                                           PRELOD  206
                C345   WRITE(61,101)(C(KI,IJ),IJ=1,IK)                         PRELOD  207
                      CALL VMULFF(C,F,NSD,IK,1,11,480,FB,11,IER)                PRELOD  208
                      HED=2HFB                                                  PRELOD  209
                C     WRITE(61,103)HED                                          PRELOD  210
      210       C     WRITE(61,101)FB                                           PRELOD  211
                      CALL VMULFF(C,ABK,NSD,IK,NSD,11,30,F1,11,IER)             PRELOD  212
                      HED=2HF1                                                  PRELOD  213
                C     WRITE(61,103)HED                                          PRELOD  214
                C     DO 346 KI=1,NSD                                           PRELOD  215
      215       C346   WRITE(61,101)(F1(KI,IJ),IJ=1,NSD)                        PRELOD  216
                      DO 350 I=1,NSD                                            PRELOD  217
                      DO 350 J=1,NSD                                            PRELOD  218
                350   F1(I,J)=F1(I,J)-BBK(I,J)                                  PRELOD  219
                      CALL VMULFF(F1,UB,NSD,NSD,1,11,11,F2,11,IER)              PRELOD  220
      220             HED=2HF2                                                  PRELOD  221
                C     WRITE(61,103)HED                                          PRELOD  222
                C     WRITE(61,101)F2                                           PRELOD  223
                      DO 360 I=1,NSD                                            PRELOD  224
                360   FB(I,1)=FB(I,1)-F2(I,1)                                   PRELOD  225
      225       C FB IS RESULTANT PRELOAD                                       PRELOD  226
                      IF(IPRINT.EQ.0)GO TO 361                                  PRELOD  227
                      WRITE(61,400)                                             PRELOD  228
                400   FORMAT(1H0,8ASSEMBLY LOAD FOR ONE FOIL*)                  PRELOD  229
```



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      DO 500 I=1,NSD                                                    PRELOD   230
230   IJ=I+IK                                                           PRELOD   231
      I1=NFT(IJ)                                                        PRELOD   232
  500 WRITE(61,510)I1,FB(I,1)                                           PRELOD   233
  510 FORMAT(1H ,*DOF(*,I2,*)=*,F10.3)                                  PRELOD   234
  351 CONTINUE                                                          PRELOD   235
235   DO 700 I=2,NSD                                                    PRELOD   236
      I1=I-1                                                            PRELOD   237
  700 PHE(I1)=FB(I,1)                                                   PRELOD   238
      C CALCULATE UNKNOWN DISP.                                         PRELOD   239
      CALL VMULFF(AAK,ABK,IK,IK,NSD,30,30,UT,30,IER)                    PRELOD   240
240   CALL VMULFF(UT,UB,IK,NSD,1,30,I1,UA,30,IER)                       PRELOD   241
      DO 800 I=1,IK                                                     PRELOD   242
  800 UA(I)=-UA(I)                                                      PRELOD   243
      IF(IPRINT.EQ.0)GO TO 819                                          PRELOD   244
      WRITE(61,810)                                                     PRELOD   245
245   810 FORMAT(1H0,*UNSPECIFIED DISPACEMENTS CALCULATED*)             PRELOD   246
      DO 820 I=1,IK                                                     PRELOD   247
      J=NUT(I)                                                          PRELOD   248
  820 WRITE(61,821)J,UA(I)                                              PRELOD   249
  821 FORMAT(1H ,*U(*,I2,*)=*,F10.6)                                    PRELOD   250
250    819 CONTINUE                                                     PRELOD   251
      DO 826 JK=1,IFOIL                                                 PRELOD   252
      IF(IPRINT.EQ.0)GO TO 829                                          PRELOD   253
      WRITE(61,850)JK                                                   PRELOD   254
  850 FORMAT(//,1X,*FOIL *,I3,/,1H ,*NODE*,12X,*RINITIAL*,19X,*U*,14X,  PRELOD   255
255     +*RFINAL*,/,                                                    PRELOD   256
        +1X,80(1H*),/)                                                  PRELOD   257
    829 CONTINUE                                                        PRELOD   258
      DO 822 I=1,NODFL                                                  PRELOD   259
      IDOF=I*NDOF-1                                                     PRELOD   260
260   IF(JDISP(IDOF).EQ.1)GO TO 823                                     PRELOD   261
      DO 824 K=1,NDOF                                                   PRELOD   262
      J=NFT(K)                                                          PRELOD   263
      IF(J.EQ.IDOF)GO TO 825                                            PRELOD   264
  824 CONTINUE                                                          PRELOD   265
265   825 IDOF=K                                                        PRELOD   266
      RF((JK-1)*NODFL+I)=R(I)-UA(IDOF)                                  PRELOD   267
      URASS(I)=UA(IDOF)                                                 PRELOD   268
      IF(IPRINT.EQ.0)GO TO 822                                          PRELOD   269
      WRITE(61,851)I,R(I),UA(IDOF),RF((JK-1)*NODFL+I)                   PRELOD   270
270   GO TO 822                                                         PRELOD   271
  823 CONTINUE                                                          PRELOD   272
      RF((JK-1)*NODFL+I)=R(I)-UR(I)                                     PRELOD   273
      URASS(I)=UR(I)                                                    PRELOD   274
      IF(IPRINT.EQ.0)GO TO 822                                          PRELOD   275
275   WRITE(61,851)I,R(I),UR(I),RF((JK-1)*NODFL+I)                      PRELOD   276
  822 CONTINUE                                                          PRELOD   277
  826 CONTINUE                                                          PRELOD   278
      C     CHECK TO SEE IF ASSEMBLY POSITION IS VALID                  PRELOD   279
      NODFL21=NODFL2-1                                                  PRELOD   280
280   DO 827 I=1,NODFL21                                                PRELOD   281
      IF(RF(I+NODFL2).LE.RF(I)-T)GO TO 827                              PRELOD   282
      C     NOT A VALID POSITION                                        PRELOD   283
      RNOT=0.995*RNOT                                                   PRELOD   284
      IF(IPRINT.EQ.0)GO TO 106                                          PRELOD   285
285   WRITE(61,828)                                                     PRELOD   286
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      828 FORMAT(1H0,1H*,*THIS IS NOT A VALID ASSEMBLY POSITION. GEOMETRY *  PRELOD   287
     +*ROUTINE WILL CONTINUE TO SEARCH.*)                                    PRELOD   288
          GO TO 106                                                          PRELOD   289
      827 CONTINUE                                                           PRELOD   290
  290     IF(IPRINT.NE.0)GO TO 840                                           PRELOD   291
          WRITE(61,835)                                                      PRELOD   292
          DO 831 I=1,NODFL                                                   PRELOD   293
          WRITE(61,851)I,RF(I)                                               PRELOD   294
      831 CONTINUE                                                           PRELOD   295
  295 835 FORMAT(1H0,*NODE*,5X,*ASSEMBLY RADIUS FROM CENTER OF BEARING*,/,   PRELOD   296
     +1X,80(1H*))                                                            PRELOD   297
      840 CONTINUE                                                           PRELOD   298
          DO 830 I=1,NODFL                                                   PRELOD   299
          DO 830 N=1,NDOF                                                    PRELOD   300
  300     IDOF=I*NDOF-(NDOF-N)                                               PRELOD   301
          IF(JOISP(IDOF).EQ.1)GO TO 830                                      PRELOD   302
          DO 832 K=1,NDFF                                                    PRELOD   303
          J=NFT(K)                                                           PRELOD   304
          IF(J.EQ.IDOF)GO TO 833                                             PRELOD   305
  305 832 CONTINUE                                                           PRELOD   306
      833 CONTINUE                                                           PRELOD   307
          U(IDOF)=UA(K)                                                      PRELOD   308
      830 CONTINUE                                                           PRELOD   309
          IF(IPLOT.GE.1)NPLOT=1                                              PRELOD   310
  310     IF(IPLOT.GE.1)CALL OVERLAY(6HISOFB1,6,4)                           PRELOD   311
          NPLOT=0                                                            PRELOD   312
      851 FORMAT(1H ,I4,3F20.4)                                              PRELOD   313
          WRITE(61,852)                                                      PRELOD   314
      852 FORMAT(1H0,80(1H*))                                                PRELOD   315
  315     DO 853 I=1,NODES                                                   PRELOD   316
      853 R(I)=RF(I)                                                         PRELOD   317
      C   FIX NODE 1                                                        PRELOD   318
          NDOISP=0                                                           PRELOD   319
          NDOISP=1                                                           PRELOD   320
  320     I1DOSP(1)=NODFL/2                                                  PRELOD   321
          I2DOSP(1)=-NODES                                                   PRELOD   322
          DO 864 I=1,IFOIL                                                   PRELOD   323
          NUM=(I-1)*NODFL+1                                                  PRELOD   324
          CALL PACK60(KODEBC(NUM),1,1)                                       PRELOD   325
  325     CALL PACK60(KODEBC(NUM),1,2)                                       PRELOD   326
          FOZ(NUM)=0.                                                        PRELOD   327
      C    SET OVERLAPING NODES                                              PRELOD   328
          IF(I.EQ.IFOIL)GO TO 864                                            PRELOD   329
          NDOISP=NDOISP+1                                                    PRELOD   330
  330     N1=I*NODFL                                                         PRELOD   331
          N2=I*NODFL+NODFL/2                                                 PRELOD   332
          I1DOSP(NDOISP)=N1                                                  PRELOD   333
          I2DOSP(NDOISP)=-N2                                                 PRELOD   334
      864 CONTINUE                                                           PRELOD   335
  335     READ(60,860)RFINAL,DELR,RINIT                                      PRELOD   336
          EC=0.                                                              PRELOD   337
          IF(RFINAL.EQ.0.)CALL RLOAD                                         PRELOD   338
          IF(RFINAL.EQ.0.)GO TO 1000                                         PRELOD   339
          IF(DELR.EQ.0.)RINIT=RFINAL                                         PRELOD   340
  340     WRITE(61,866)RFINAL                                                PRELOD   341
      866 FORMAT(1H0,*SHAFT RADIUS = *,F10.4)                                PRELOD   342
          KEC=0                                                              PRELOD   343
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                IEC=0                                                                   PRELOD   344
                READ(60,860)EFINAL,DELF,EINIT                                           PRELOD   345
      345       READ(60,860)PSI                                                         PRELOD   346
                WRITE(61,865)EFINAL,DELE,EINIT,PSI                                      PRELOD   347
            865 FORMAT(1H0,*EFINAL,DELF,EINIT,PSI    =*,4E15.5)                         PRELOD   348
                RS=RFINAL                                                               PRELOD   349
                EC=0.                                                                   PRELOD   350
      350       IF(RFINAL.LE.RB-2.*T)GO TO 861                                          PRELOD   351
                WRITE(61,862)                                                           PRELOD   352
            862 FORMAT(1H0,*WARNING....RFINAL TO LARGE. RFINAL RESET.*)                 PRELOD   353
                RFINAL=RB-2.*T                                                          PRELOD   354
            861 CONTINUE                                                                PRELOD   355
      355       IF(DELR.EQ.0.)GO TO 867                                                 PRELOD   356
                WRITE(61,863)RFINAL,DELR,RINIT                                          PRELOD   357
            863 FORMAT(1H0,*RFINAL,DELR,RINIT -*,3F15.5)                                PRELOD   358
            859 FORMAT(1H0,*RFINAL    ,DELR*)                                           PRELOD   359
            860 FORMAT(3F10.0)                                                          PRELOD   360
      360     867 CONTINUE                                                              PRELOD   361
            C       FIND NODE WITH MINIMUM RADIUS                                       PRELOD   362
                CALL SHAFTBC(RP,RINIT,RFINAL,DELR,RMINF,KEC,ICHNG)                      PRELOD   363
                CALL MEMSET(RSP(1),RSP(160),RP)                                         PRELOD   364
                IF(RMINF.GE.RFINAL)GO TO 1000                                           PRELOD   365
      365       868 FORMAT(1H ,*NODE *,I3,* SET*)                                       PRELOD   366
            869 CONTINUE                                                                PRELOD   367
                DO 901 K=1,IFOIL                                                        PRELOD   368
                I1=(K-1)*NODFL+2                                                        PRELOD   369
                I2=K*NODFL                                                              PRELOD   370
      370       DO 900 I=I1,I2                                                          PRELOD   371
                CALL UNPCK60(KQUEBC(I),L,2)                                             PRELOD   372
                IF(L.EQ.0)GO TO 900                                                     PRELOD   373
                IF(NODSET(I).EQ.0)GO TO 900                                             PRELOD   374
                FDR(I)=R(I)-RSP(I)                                                      PRELOD   375
      375       DO 898 N=1,NDDISP                                                       PRELOD   376
                IF(I.EQ.IABS(IDDSP(N)).AND.I.LT.NODES-NODFL/2+2)FDR(I)=R(I)-RSP      PRELOD   377
               *(I)-I                                                                   PRELOD   378
            898 CONTINUE                                                                PRELOD   379
            900 CONTINUE                                                                PRELOD   380
      380   901 CONTINUE                                                                PRELOD   381
            1000 CONTINUE                                                               PRELOD   382
                IF(RFINAL.EQ.0.)CALL LOAD                                               PRELOD   383
            C       ASSEMBLE K MATRIX                                                   PRELOD   384
                IF(MM.GT.NN)MM=NN                                                       PRELOD   385
      385       871 FORMAT(1H ,*NODSET(8)=*,I3)                                         PRELOD   386
                CALL OVERLAY(6HISOFB1,6,1)                                              PRELOD   387
            870 CALL OVERLAY(6HISOFB1,6,2)                                              PRELOD   388
                CALL OVERLAY(6HISOFB1,6,3)                                              PRELOD   389
            C       ADD IN ASSEMBLY LOAD FOR TOTAL LOADS                                PRELOD   390
      390       IF(IPRINT.EQ.0)GO TO 872                                                PRELOD   391
                WRITE(61,874)                                                           PRELOD   392
                DO 878 J=1,IFOIL                                                        PRELOD   393
                I1=(J-1)*NODFL+1                                                        PRELOD   394
                I2=J*NODFL                                                              PRELOD   395
      395       DO 875 I=I1,I2                                                          PRELOD   396
                IDOF=I*NDOF-1                                                           PRELOD   397
                DO 873 L=1,NSD                                                          PRELOD   398
                K=L+IK                                                                  PRELOD   399
            C   IF(IFT(K).EQ.IDOF)F(IDOF+(J-1)*NDFF)=F(IDOF+(J-1)*NDFF)+FB(L,I)      PRELOD   400
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      873   CONTINUE                                                          PRELOD   401
            WRITE(61,876)I,(B(JB,I),JB=1,NDOF)                                PRELOD   402
      875   CONTINUE                                                          PRELOD   403
      878   CONTINUE                                                          PRELOD   404
            WRITE(61,877)                                                     PRELOD   405
      874   FORMAT(//,1H0,*TOTAL LOADS  (INCLUDES ASSEMBLY LOAD)*,//          PRELOD   406
           *,1X,*NODE*,5X,*TANGENTIAL*,10X,*RADIAL*,14X,*ROTATIONAL*,/        PRELOD   407
           *,1X,50(1H*))                                                      PRELOD   408
      876   FORMAT(1H ,I2,3(E15.5))                                           PRELOD   409
      877   FORMAT(1H ,50(1H*))                                               PRELOD   410
       872  CONTINUE                                                          PRELOD   411
      C      CHECK LOADS FOR CORRECT SIGN                                     PRELOD   412
            ISET=0                                                            PRELOD   413
            DO 1015 K=1,IFOIL                                                 PRELOD   414
            I1=(K-1)*NODFL+2                                                  PRELOD   415
            I2=K*NODFL                                                        PRELOD   416
            DO 1010I=I1,I2                                                    PRELOD   417
            IDOF=I*NDOF-1                                                     PRELOD   418
            DO 1009 N=1,NDDISP                                                PRELOD   419
            N1=I1DDSP(N)                                                      PRELOD   420
            N2=IABS(I2DDSP(N))                                                PRELOD   421
            IF(I.EQ.N1.OR.I.EQ.N2)GO TO 1003                                  PRELOD   422
      1009  CONTINUE                                                          PRELOD   423
            CALL UNPCK60(KODEBC(I),L,2)                                       PRELOD   424
            IF(L.EQ.0)GO TO 1010                                              PRELOD   425
            IF(IPRINT.NE.0)WRITE(61,999)I,UR(I),IDOF,F(IDOF)                  PRELOD   426
      C      SEPERATE B.C. NODES                                              PRELOD   427
            IF(NODSET(I).NE.0)GO TO 1008                                      PRELOD   428
      1007  CONTINUE                                                          PRELOD   429
            GO TO 1005                                                        PRELOD   430
      1008  CONTINUE                                                          PRELOD   431
      999   FORMAT(1H ,*UR(*,I3,*)=*,E12.5,3X,*F(*,I3,*)=*,E12.5)             PRELOD   432
            IF(UR(I).GE.0..AND.F(IDOF).GE.0.)GO TO 1010                       PRELOD   433
            IF(UR(I).LE.0..AND.F(IDOF).LE.0.)GO TO 1010                       PRELOD   434
            ISET=1                                                            PRELOD   435
            CALL PACK60(KODEBC(I),0,2)                                        PRELOD   436
            FOR(I)=0.                                                         PRELOD   437
            NNODST=NNODST-1                                                   PRELOD   438
            NODSET(I)=0                                                       PRELOD   439
            IF(IPRINT.NE.0)WRITE(61,1011)I                                    PRELOD   440
            GO TO 1010                                                        PRELOD   441
      1005  CONTINUE                                                          PRELOD   442
            IF(UR(I)*F(IDOF).LT.0.)GO TO 1010                                 PRELOD   443
            IF(F(IDOF).GT.FORCES(I))GO TO 1010                                PRELOD   444
            IF(IPRINT.NE.0.OR.MPRINT.EQ.1)WRITE(61,1013)I                     PRELOD   445
      1013  FORMAT(1H ,*B.C. NODE*,I3,* RELEASED*)                            PRELOD   446
            CALL PACK60(KODEBC(I),0,2)                                        PRELOD   447
            FOR(I)=0.                                                         PRELOD   448
            ISET=1                                                            PRELOD   449
      1011  FORMAT(1H ,*RELEASE NODE *,I3)                                    PRELOD   450
            GO TO 1010                                                        PRELOD   451
      1003  CONTINUE                                                          PRELOD   452
      C      CHECK B.C. FOR DISP PAIRS                                        PRELOD   453
            CALL UNPCK60(KODEBC(N2),L,2)                                      PRELOD   454
            IF(L.EQ.0)GO TO 1010                                              PRELOD   455
            IF(NODSET(N2).EQ.0)GO TO 1004                                     PRELOD   456
            IF(F(N2*NDOF-1)*F(N1*NDOF-1).LE.0.)GO TO 1010                     PRELOD   457
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                CALL PACK60(KODEBC(N2),0,2)                                    PRELOD   458
                FOR(N2)=0.                                                     PRELOD   459
                ISET=1                                                         PRELOD   460
460             NODSET(N2)=0                                                   PRELOD   461
                IF(IPRINT.NE.0)WRITE(61,1011)N2                                PRELOD   462
                GO TO 1010                                                     PRELOD   463
             1004 CONTINUE                                                     PRELOD   464
                C     DDISP WITH B.C.                                          PRELOD   465
465             IF(F(N2*NDOF-1)*F(N1*NDOF-1).GE.0.)GO TO 1010                  PRELOD   466
                C     FIND INSIDE NODE                                         PRELOD   467
                NM=N2                                                          PRELOD   468
                IF(I.GT.NODFL/2.AND.I.LE.(IFOIL)*NODFL-NODFL/2)NM=N1           PRELOD   469
                IF(F(N2*NDOF-1)*F(N1*NDOF-1).GT.FORCES(NM))GO TO 1010          PRELOD   470
470             CALL PACK60(KODEBC(N2),0,2)                                    PRELOD   471
                FOR(N2)=0.                                                     PRELOD   472
                ISET=1                                                         PRELOD   473
                IF(IPRINT.NE.0.OR.MPRINT.EQ.1)WRITE(61,1013)N2                 PRELOD   474
             1010 CONTINUE                                                     PRELOD   475
475          1015 CONTINUE                                                     PRELOD   476
                IF(ISET.EQ.1)GO TO 1000                                        PRELOD   477
              1016 CONTINUE                                                    PRELOD   478
                IF(RFINAL.EQ.0.)KEC=1                                          PRELOD   479
                C     CHECK TO SEE IF ALL NODES ARE LIFTED                     PRELOD   480
480             C     CHECK TO SEE IF MORE NODES NEED TO BE SET                PRELOD   481
                CALL SHAFT2(RSP,RINIT,RFINAL,DELR,RMINF,KEC,ICHNG)             PRELOD   482
                IF(ICHNG.EQ.0)GO TO 1050                                       PRELOD   483
                GO TO 869                                                      PRELOD   484
             1050 CONTINUE                                                     PRELOD   485
485             C     CHECK TO SEE IF DISP PAIRS NEED TO BE RELEASED           PRELOD   486
                IREL=0                                                         PRELOD   487
                DO 1100 I=1,NDDISP                                             PRELOD   488
                I1=I1DDSP(I)                                                   PRELOD   489
                IF(I1.EQ.0)GO TO 1100                                          PRELOD   490
490             I2=IABS(I2DDSP(I))                                             PRELOD   491
                C     CHECK FOR B.C. NODE                                      PRELOD   492
                CALL UNPCK60(KODEBC(I2),L,2)                                   PRELOD   493
                IF(L.EQ.1)GO TO 1100                                           PRELOD   494
                C     CHECK TO SEE IF FORCE OF DEP. NODE IS PROPER SIGN        PRELOD   495
495             IF(I2.GT.NODFL/2.AND.I2.LE.(IFOIL)*NODFL-NODFL/2)GO TO 1060    PRELOD   496
                IF(F(I1*NDOF-1).LE.0.)GO TO 1100                               PRELOD   497
             1065 IREL=IREL+1                                                  PRELOD   498
                I1DDSP(I)=0                                                    PRELOD   499
                I2DDSP(I)=0                                                    PRELOD   500
500             DDISPY(I)=0.                                                   PRELOD   501
                GO TO 1070                                                     PRELOD   502
             1060 CONTINUE                                                     PRELOD   503
                IF(F(I1*NDOF-1).GT.0.)GO TO 1100                               PRELOD   504
                IF(F(I1*NDOF-1).GT.FORCES(I1))GO TO 1100                       PRELOD   505
505             GO TO 1065                                                     PRELOD   506
             1070 CALL PACK60(KODEBC(I1),0,2)                                  PRELOD   507
                IF(IPRINT.EQ.0.AND.MPRINT.EQ.0)GO TO 1100                      PRELOD   508
                WRITE(61,1101)I1,I2                                            PRELOD   509
             1101 FORMAT(1H0,*NODES*,I3,* AND*,I3,*RELEASED AS DISP. PAIRS*)   PRELOD   510
510          1100 CONTINUE                                                     PRELOD   511
                IF(IREL.NE.0)GO TO 1000                                        PRELOD   512
                C     CHECK FOR NEW DISP PAIRS                                 PRELOD   513
                ISPEC=0                                                        PRELOD   514
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```
                      IDDSP=NDDISP                                                    PRELOD   515
  515                 NODFL2=NODFL/2                                                  PRELOD   516
                      NOD21=NODFL/2+2                                                 PRELOD   517
                      DO 1112 J=1,IFOIL                                               PRELOD   518
                      I1=(J-1)*NODFL+NOD21                                            PRELOD   519
                      I2=J*NODFL                                                      PRELOD   520
  520                 DO 1110 I=I1,I2                                                 PRELOD   521
                      DO 1109 N=1,NDDISP                                              PRELOD   522
                      IF(I.EQ.IABS(I2DDSP(N)))GO TO 1110                              PRELOD   523
                      IF(I.EQ.I1DDSP(N))GO TO 1110                                    PRELOD   524
                 1109 CONTINUE                                                        PRELOD   525
  525                 N2=1                                                            PRELOD   526
                      N1=I+NODFL2                                                     PRELOD   527
                      IF(J.EQ.IFOIL)N2=NODFL2-(NODES-I)                               PRELOD   528
                      IF(J.EQ.IFOIL)N1=I                                              PRELOD   529
                 C     CHECK IF IND. NODE IS ON LAST HALF OF LAST FOIL                PRELOD   530
  530                 IF(N1.GT.NODFL/2.AND.N1.LE.(IFOIL)*NODFL-NODFL/2)GO TO 1108     PRELOD   531
                      IF(RF(N2)-RF(N1)-.999*T)1105,1110,1110                          PRELOD   532
                 1105 CONTINUE                                                        PRELOD   533
                 C     CHECK TO SEE IF DEP. NODE IS B.C.                              PRELOD   534
                      CALL UNPCK60(KODEBC(N2),1,2)                                    PRELOD   535
  535                 IF(L.EQ.1.AND.NODSET(N2).EQ.0)GO TO 1106                        PRELOD   536
                      NDDISP=NDDISP+1                                                 PRELOD   537
                      I1DDSP(NDDISP)=N2                                               PRELOD   538
                      I2DDSP(NDDISP)=-N1                                              PRELOD   539
                      DDISPY(NDDISP)=R(N2)-T-R(N1)                                    PRELOD   540
  540                 C     CHECK IF IND. NODE IS ON LAST HALF OF LAST FOIL           PRELOD   541
                      IF(N1.GT.NODFL/2.AND.N1.LE.(IFOIL)*NODFL-NODFL/2)DDISPY(NDDISP)= PRELOD   542
                     +R(N2)-R(N1)+T                                                   PRELOD   543
                      IF(IPRINT.EQ.0.AND.MPRINT.EQ.0)GO TO 1110                       PRELOD   544
                      WRITE(61,1111)NDDISP,N1,N2,DDISPY(NDDISP)                       PRELOD   545
  545                 GO TO 1110                                                      PRELOD   546
                 1108 CONTINUE                                                        PRELOD   547
                      IF(RF(N1)-RF(N2)-.999*T)1105,1110,1110                          PRELOD   548
                 1106 CONTINUE                                                        PRELOD   549
                 C     SET NODE N1 AS SPEC. DISP.                                     PRELOD   550
  550                 IF(J.NE.IFOIL)GO TO 1104                                        PRELOD   551
                      CALL PACK60(KODEBC(N1),1,2)                                     PRELOD   552
                      ISPEC=1                                                         PRELOD   553
                      FOR(N1)=R(N1)-(RB-2.*T)                                         PRELOD   554
                      IF(IPRINT.EQ.0.AND.MPRINT.EQ.0)GO TO 1110                       PRELOD   555
  555                 WRITE(61,1131)N1                                                PRELOD   556
                      GO TO 1110                                                      PRELOD   557
                  1104 CONTINUE                                                       PRELOD   558
                 C     DEP NODE IS ON SHAFT                                           PRELOD   559
                 1107 CONTINUE                                                        PRELOD   560
  560            1111 FORMAT(1H0,*NDDISP,N1,N2,DDISPY(NDDISP)=    *,3I5,E15.5)       PRELOD   561
                 1110 CONTINUE                                                        PRELOD   562
                 1112 CONTINUE                                                        PRELOD   563
                      IF(IDDSP.NE.NDDISP)GO TO 1000                                   PRELOD   564
                      IF(ISPEC.EQ.1)GO TO 1000                                        PRELOD   565
  565            1120 CONTINUE                                                        PRELOD   566
                 C     CHECK FOR BOUNDRY CONDITION VIOLATIONS                         PRELOD   567
                      IBC=0                                                           PRELOD   568
                      DO 1151 J=1,IFOIL                                               PRELOD   569
                      I1=(J-1)*NODFL+2                                                PRELOD   570
  570                 I2=I1+NODFL/2-1                                                 PRELOD   571
```

```
      DO 1150 KZ=I1,12                                                  PRELOD  572
      I=KZ                                                              PRELOD  573
      DO 1130 N=1,NODISP                                                PRELOD  574
      IF(I.EQ.I1DDSP(N).AND.I.LE.NODFL/2)I=(((IFOIL-1)*NODFL)+NODFL/2+I PRELOD  575
575   1130 CONTINUE                                                     PRELOD  576
      E=T                                                               PRELOD  577
      IF(I.GE.(J-1)*NODFL+NODFL/2+1)E=2.*T                              PRELOD  578
      ROUND=(RF(I)+0.00005)*10000.                                      PRELOD  579
      IROUND=ROUND                                                      PRELOD  580
      RFROUND=FLOAT(IROUND)/10000.                                      PRELOD  581
580   IF(RFROUND.LE.RB-E)GO TO 1150                                     PRELOD  582
      IF(RF(I).LE.RB-E)GO TO 1150                                       PRELOD  583
      IF(ABS(RF(I)/(RB-E)).LE..0005*T) GO TO 1150                       PRELOD  584
C      NODE I VIOLATES B.C.                                             PRELOD  585
585   CALL PACK60(KODEBC(I),1,2)                                        PRELOD  586
      IBC=1                                                             PRELOD  587
      FOR(I)=R(I)-(RB-E)                                                PRELOD  588
      IF(I.EQ.I1DDSP(N).AND.I.LE.NODFL/2)I=I-(((IFOIL-1)*NODFL)-NODFL/2 PRELOD  589
      IF(IPRINT.EQ.0.AND.MPRINT.EQ.0)GO TO 1151                         PRELOD  590
590   WRITE(61,1131)I                                                   PRELOD  591
      GO TO 1151                                                        PRELOD  592
1131  FORMAT(1H0,*NODE*,I3,* VIOLATES B.C.*CONSTRAIN*)                  PRELOD  593
1150  CONTINUE                                                          PRELOD  594
1151  CONTINUE                                                          PRELOD  595
      IF(IHC.EQ.1)GO TO 1000                                            PRELOD  596
595   IF(RFINAL.EQ.0.)GO TO 1501                                        PRELOD  597
      IF(REC.EQ.1)GO TO 1500                                            PRELOD  598
      IF(RSP.EQ.RFINAL)GO TO 1500                                       PRELOD  599
      RSP=RSP+DELR                                                      PRELOD  600
      DO 1200 I=1,NODES                                                 PRELOD  601
600   NODSET(I)=IABS(NODSET(I))                                         PRELOD  602
1200  CONTINUE                                                          PRELOD  603
      IF(RSP.GT.RFINAL)RSP=RFINAL                                       PRELOD  604
      GO TO 869                                                         PRELOD  605
605   1500 CONTINUE                                                     PRELOD  606
      IF(REC.EQ.0)CALL EMOD(RSP,RS,PSI)                                 PRELOD  607
1501  CONTINUE                                                          PRELOD  608
      IF(IPLOT.GE.2)CALL OVERLAY(6HISOFB1,6,4)                          PRELOD  609
      RFX=0.                                                            PRELOD  610
610   RFY=0.                                                            PRELOD  611
      CALL MEMSET(PRE(1),PRE(160),0.)                                   PRELOD  612
C      FIND NODES ON SHAFT                                              PRELOD  613
      NODFL21=NODFL/2+1                                                 PRELOD  614
      IF(IPRINT.EQ.0)IPRINT=-1                                          PRELOD  615
615   IF(MPRINT.EQ.0)CALL OVERLAY(6HISOFB1,6,3)                         PRELOD  616
      IF(IPRINT.EQ.-1)IPRINT=0                                          PRELOD  617
      WRITE(61,1690)EC                                                  PRELOD  618
      WRITE(61,1610)                                                    PRELOD  619
      DO 1601 J=1,IFOIL                                                 PRELOD  620
620   I1=(J-1)*NODFL+NODFL21                                            PRELOD  621
      I2=J*NODFL                                                        PRELOD  622
      DO 1600 II=I1,I2                                                  PRELOD  623
      I=II                                                              PRELOD  624
C      CHECK FOR DISP. PAIRS                                            PRELOD  625
      DO 1580 N=1,NODISP                                                PRELOD  626
625   IF(I.EQ.I1DDSP(N))I=IABS(I2DDSP(N))                               PRELOD  627
      CALL UNPCK60(KODEBC(I),L,2)                                       PRELOD  628
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C***** THIS STATEMENT RELEASES SHAFT NODES ON THE LAST ITERATION          PRELOD  629
C     BEFORE USE OF SPECIFIED LOADS.                                     PRELOD  630
      IF(L.EQ.1.AND.NODSET(I).NE.0.AND.IEC.EQ.1)CALL PACK60(KODEBC(I),   PRELOD  631
     +0,2)                                                               PRELOD  632
C*************                                                           PRELOD  633
      IF(I.EQ.IABS(I2DDSP(N)))GO TO 1590                                 PRELOD  634
 1580 CONTINUE                                                           PRELOD  635
      IF(B(2,I).GE.0.)GO TO 1600                                         PRELOD  636
C      CALCULATE SHAFT LOAD ON NON DDISP                                 PRELOD  637
      PRE(I)=B(2,I)                                                      PRELOD  638
      GO TO 1599                                                         PRELOD  639
 1590 CONTINUE                                                           PRELOD  640
      IF(B(2,I)+B(2,I1DDSP(N)).GE.0.)GO TO 1600                          PRELOD  641
C      CALCULATE SHAFT LOAD ON DDISP NODE                                PRELOD  642
      PRE(II)=B(2,I)+B(2,I1DDSP(N))                                      PRELOD  643
 1599 CONTINUE                                                           PRELOD  644
      PREX=-PRE(II)*SIN(THETA(II))                                       PRELOD  645
      PREY=-PRE(II)*COS(THETA(II))                                       PRELOD  646
      RFX=RFX+PREX                                                       PRELOD  647
      RFY=RFY+PREY                                                       PRELOD  648
      WRITE(61,1612)I1,PRE(II),PREX,PREY                                 PRELOD  649
 1612 FORMAT(1H ,I5,3X,3(F10.3,3X))                                      PRELOD  650
 1600 CONTINUE                                                           PRELOD  651
 1601 CONTINUE                                                           PRELOD  652
 1610 FORMAT(1H0,*SHAFT LOADS*,/,1X,*NODE*,3X,*TOTAL LOAD*,8X,*FX*,13X,  PRELOD  653
     +*FY*)                                                              PRELOD  654
      WRITE(61,1611)                                                     PRELOD  655
 1611 FORMAT(1H ,30(1H*))                                                PRELOD  656
      RFT=SQRT(RFX**2+RFY**2)                                            PRELOD  657
      IF(RFT.EQ.0.)GO TO 1614                                            PRELOD  658
      RFA=ATAN2(RFX,RFY)                                                 PRELOD  659
 1614 CONTINUE                                                           PRELOD  660
      WRITE(61,1613)RFX,RFY,RFT,RFA                                      PRELOD  661
 1613 FORMAT(16X,*RESULTANT FORCE-X   RESULTANT FORCE-Y   TOTAL FORCE*   PRELOD  662
     +*          ANGLE*,/,1X,4F20.4)                                     PRELOD  663
      WRITE(61,1611)                                                     PRELOD  664
      IF(RFINAL.EQ.0.)GO TO 1700                                         PRELOD  665
      IF(IEC.EQ.1)GO TO 1700                                             PRELOD  666
      EC=EC+DELE                                                         PRELOD  667
      IF(EC.GE.EFINAL)IEC=1                                              PRELOD  668
      IF(KEC.EQ.0.AND.EINIT.NE.0.)EC=EINIT                               PRELOD  669
      KEC=1                                                              PRELOD  670
      IF(EC.GT.EFINAL)EC=EFINAL                                          PRELOD  671
      CALL EMOD(RSP,RS,PSI)                                              PRELOD  672
      DO 1620 I=1,NODES                                                  PRELOD  673
      NODSET(I)=IABS(NODSET(I))                                          PRELOD  674
 1620 CONTINUE                                                           PRELOD  675
      GO TO 1016                                                         PRELOD  676
 1490 FORMAT(1H0,10(1H*),3X,*ECCENTRICITY= *,F10.6)                      PRELOD  677
 1700 CONTINUE                                                           PRELOD  678
 1800 CONTINUE                                                           PRELOD  679
      IF(ITERATE.NE.0)REWIND 15                                          PRELOD  680
      WRITE(15)(RK(I),I=1,900)                                           PRELOD  681
      REWIND 15                                                          PRELOD  682
      END                                                                PRELOD  683
```



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| CARD NR. | SEVERITY | DETAILS | DIAGNOSIS OF PROBLEM |
|---|---|---|---|
| 30 | I | | ARRAY REFERENCE OUTSIDE DIMENSION BOUNDS. |
| 598 | I | RSP | ARRAY NAME OPERAND NOT SUBSCRIPTED. FIRST ELEMENT WILL BE USED. |
| 599 | I | RSP | ARRAY NAME OPERAND NOT SUBSCRIPTED. FIRST ELEMENT WILL BE USED. |
| 599 | I | RSP | ARRAY NAME OPERAND NOT SUBSCRIPTED. FIRST ELEMENT WILL BE USED. |
| 603 | I | RSP | ARRAY NAME OPERAND NOT SUBSCRIPTED. FIRST ELEMENT WILL BE USED. |
| 603 | I | RSP | ARRAY NAME OPERAND NOT SUBSCRIPTED. FIRST ELEMENT WILL BE USED. |
| 680 | I | | ARRAY REFERENCE OUTSIDE DIMENSION BOUNDS. |



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      SUBROUTINE LOAD                                                    LOAD       2
      COMMON/FOR/FORCES(160)                                             LOAD       3
      COMMON/FOILLY/IFOIL,NODFL                                          LOAD       4
      COMMON/PDDISP/NDDISP,I1DDSP(160),I2DDSP(160)                       LOAD       5
      COMMON/BCP/KODEBC(160),FDZ(160),FDR(160)                           LOAD       6
      COMMON/SYMSOL/NN,MM,NNPE,NDOF,NVECT,NODES                          LOAD       7
      COMMON/SET/NODSET(160)                                             LOAD       8
C                                                                        LOAD       9
C                                                                        LOAD      10
      DO 10 I=1,NODES                                                    LOAD      11
      CALL UNPCK60(KODEBC(I),L,2)                                        LOAD      12
      IF(L.EQ.0)FDH(I)=0.                                                LOAD      13
   10 CONTINUE                                                           LOAD      14
C                                                                        LOAD      15
C     LOAD FORCES                                                        LOAD      16
      DO 110 J=1,IFOIL                                                   LOAD      17
      DO 100 I=1,NODFL                                                   LOAD      18
      II=(J-1)*NODFL+I                                                   LOAD      19
      II=II                                                              LOAD      20
      IF(FORCES(II).EQ.0.)GO TO 21                                       LOAD      21
       DO 20 N=1,NDDISP                                                  LOAD      22
      IF(II.NE.I1DDSP(N))GO TO 20                                        LOAD      23
C     II IS DEPENDENT NODE. MUST TRANSFER FORCE TO INDEPENDENT NODE      LOAD      24
      II=IABS(I2DDSP(N))                                                 LOAD      25
      GO TO 21                                                           LOAD      26
   20 CONTINUE                                                           LOAD      27
   21 CONTINUE                                                           LOAD      28
      CALL UNPCK60(KODEBC(II),L,2)                                       LOAD      29
      IF(L.NE.0)GO TO 100                                                LOAD      30
      FDR(II)=FDR(II)+FORCES(II)                                         LOAD      31
  100 CONTINUE                                                           LOAD      32
  110 CONTINUE                                                           LOAD      33
      RETURN                                                             LOAD      34
C                                                                        LOAD      35
C                                                                        LOAD      36
C     FOR TEMPORARY INPUT OF FORCES                                      LOAD      37
      ENTRY RLOAD                                                        LOAD      38
      READ(60,900)NFOR                                                   LOAD      39
  900 FORMAT(I5)                                                         LOAD      40
      DO 200 I=1,NFOR                                                    LOAD      41
      READ(60,901)RNOD,FOR                                               LOAD      42
  901 FORMAT(2F10.0)                                                     LOAD      43
      NOD=RNOD                                                           LOAD      44
      FORCES(NOD)=FOR                                                    LOAD      45
  200 CONTINUE                                                           LOAD      46
      WRITE(61,902)(I,FORCES(I),I=1,NODES)                               LOAD      47
  902 FORMAT(1H0,1X,5( 1X,*FORCES(*,I3,*)= *,F10.3,3X))                  LOAD      48
      RETURN                                                             LOAD      49
      END                                                                LOAD      50
```

```
      SUBROUTINE EMOD(RSP,RS,PSI)                                        EMOD       2
      COMMON/SYMSOL/NN,MM,NNPE,NDOF,NVECT,NODES                          EMOD       3
      COMMON/FOILLY/IFOIL,NODFL                                          EMOD       4
      COMMON/RT/RS1,RB,R0,T,RFF,RL                                       EMOD       5
      COMMON/LOD/F(480,1),JDTSP(30),S(6,6),RK(30,30),UR(160)             EMOD       6
      COMMON/CURBMZ/TITLE(8),ICM(30),FNOA(10)                            EMOD       7
      COMMON/PDEL/R(160),RF(162),XRSP(160),URASS(10),RFREE(10)           EMOD       8
      COMMON/ECC/THETA(160)                                              EMOD       9
      COMMON/PLOTQ/IPLOT(2),IPRINT                                       EMOD      10
      COMMON/EC/E                                                        EMOD      11
      DIMENSIONRSP(160),A(1),B(1),C(2)                                   EMOD      12
C     CALCULATE ANGLE TO EACH NODE                                       EMOD      13
      RFOIL=IFOIL                                                        EMOD      14
      DO 20 I=1,IFOIL                                                    EMOD      15
      DO 10 J=1,NODFL                                                    EMOD      16
      JI=(I-1)*NODFL+J                                                   EMOD      17
      J1=J*NDOF-2                                                        EMOD      18
      J2=J*NDOF-1                                                        EMOD      19
      PHI=FNOA(J)+(I-1)*2.*3.14159/RFOIL                                 EMOD      20
      DELR=URASS(J)*UR(JI)                                               EMOD      21
      ZETA=0.                                                            EMOD      22
      ANGLE=PHI+ZETA                                                     EMOD      23
      THETA(JI)=ANGLE-PSI                                                EMOD      24
      IF(IPRINT.EQ.0)GO TO 10                                            EMOD      25
      WRITE(61,901)JI,ANGLE,PHI,ZETA,THETA(JI)                           EMOD      26
  901 FORMAT(1H ,*NODE,ANGLE,PHI,ZETA,THETA=*,I3,4E15.5)                 EMOD      27
   10 CONTINUE                                                           EMOD      28
   20 CONTINUE                                                           EMOD      29
C     CALCULATE MIN POSITION OF NODE                                     EMOD      30
      DO 40 I=1,IFOIL                                                    EMOD      31
      DO 40 J=1,NODFL                                                    EMOD      32
      JI=(I-1)*NODFL+J                                                   EMOD      33
      A(1)=-2.*E*COS(THETA(JI))                                          EMOD      34
      B(1)=(2.*E*COS(THETA(JI)))**2-4.*(E**2-RS**2)                      EMOD      35
      NV=1                                                               EMOD      36
      NC=2                                                               EMOD      37
      CALL QUAD(A,B,NV,C,NC,TER,NER)                                     EMOD      38
      IF(NER.EQ.0)GO TO 50                                               EMOD      39
C     IMAGINARYSOLUTION                                                  EMOD      40
      WRITE(61,902)A,B,JI                                                EMOD      41
  902 FORMAT(1H0,* IMAGINARY SOLUTION    A,B,NODE=    *,2E15.5,I5)       EMOD      42
      CALL EXIT                                                          EMOD      43
   50 CONTINUE                                                           EMOD      44
      IF(C(1).GE.0..AND.C(2).GE.0.)GO TO 100                             EMOD      45
C     ONE IS BAD                                                         EMOD      46
      IF(C(1).LT.0.)K=2                                                  EMOD      47
      IF(C(2).LT.0.)K=1                                                  EMOD      48
      IF(C(1).LT.0..AND.C(2).LT.0.)GO TO 60                              EMOD      49
      GO TO 110                                                          EMOD      50
   60 CONTINUE                                                           EMOD      51
C     NEITHER SOLUTION IS VALID                                          EMOD      52
      WRITE(61,903)C(1),C(2),JI                                          EMOD      53
  903 FORMAT(1H0,*NO SOLUTION FOR ECCENTRICITIES  C(1),C(2),NODE=*,      EMOD      54
     *2E15.5,I5)                                                         EMOD      55
      CALL EXIT                                                          EMOD      56
  100 CONTINUE                                                           EMOD      57
C     POSSIBLE BOTH ARE GOOD                                             EMOD      58
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      IF(C(1)/2..GT.RB-T.AND.C(2)/2..GT.RB-T)GO TO 60                    EMOD   59
      IF(C(1)/2..LE.RB-T)K=1                                             EMOD   60
60    IF(C(2)/2..LE.RB-T)K=2                                             EMOD   61
  110 CONTINUE                                                           EMOD   62
      RSP(JI)=C(K)/2.                                                    EMOD   63
   40 CONTINUE                                                           EMOD   64
      NODES=IFOIL*NODFL                                                  EMOD   65
65    WRITE(6,904)(I,RSP(I),I=1,NODES)                                   EMOD   66
  904 FORMAT(1H ,3(1X,*RSP(*,I3,*)= *,E15.6,3X))                         EMOD   67
  200 CONTINUE                                                           EMOD   68
      RETURN                                                             EMOD   69
      END                                                                EMOD   70
```



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      SUBROUTINE INVERT (S,M,ND,NERR)                                   EMOD    71
C     INVERTS THE SYMMETRIC MATRIX S                                    EMOD    72
      DIMENSION S(ND,ND)                                                EMOD    73
C     M IS THE MATRIX SIZE                                              EMOD    74
C     NERR IS AN ERROR INDICATOR -- 1= OK,   2= FAILURE                 EMOD    75
   10 DO 110 J=1,M                                                      EMOD    76
      IJ=J-1                                                            EMOD    77
C     SWEEP OUT ALL ROWS EXCEPT PIVOTAL ROW J                           EMOD    78
      XPIV=S(J,J)                                                       EMOD    79
      IF (XPIV.EQ.0.)GO TO 130                                          EMOD    80
      DO 90 I=1,M                                                       EMOD    81
      IF (J-I)40,90,20                                                  EMOD    82
   20 JC=J                                                              EMOD    83
      AX=S(I,J)/XPIV                                                    EMOD    84
      DO 30 K=1,I                                                       EMOD    85
   30 S(I,K)=S(I,K)-AX*S(J,K)                                           EMOD    86
   25 CONTINUE                                                          EMOD    87
      GO TO 70                                                          EMOD    88
   40 JC=I                                                              EMOD    89
      AX=S(J,I)/XPIV                                                    EMOD    90
      IF (IJ)70,70,50                                                   EMOD    91
   50 DO 60 K=1,IJ                                                      EMOD    92
   60 S(I,K)=S(I,K)-AX*S(J,K)                                           EMOD    93
   70 DO 80 K=JC,M                                                      EMOD    94
   80 S(I,K)=S(I,K)-AX*S(J,K)                                           EMOD    95
      S(I,J)=-AX                                                        EMOD    96
   90 CONTINUE                                                          EMOD    97
C                                                                       EMOD    98
C     SWEEP OUT PIVOTAL ROW J                                           EMOD    99
C                                                                       EMOD   100
      DO 100 K=1,M                                                      EMOD   101
  100 S(J,K)=S(J,K)/XPIV                                                EMOD   102
      S(J,J)=S(J,J)/XPIV                                                EMOD   103
CCCCC IF ACCUMULATOR OVERFLOW 1017,1024                                 EMOD   104
  110 CONTINUE                                                          EMOD   105
      DO 120 I=1,M                                                      EMOD   106
      DO 120 J=1,M                                                      EMOD   107
  120 S(I,J)=S(J,I)                                                     EMOD   108
      NERR=1                                                            EMOD   109
      RETURN                                                            EMOD   110
  130 NERR=2                                                            EMOD   111
      RETURN                                                            EMOD   112
      END                                                               EMOD   113
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      SUBROUTINE FGEO(SA,R2,RNOT,IPASS)                                  FGEO    2
      REAL L                                                             FGEO    3
      COMMON/RT/RS1,RB,R0,T,RFF,RL                                       FGEO    4
      COMMON/FOILLY/IFOIL,NODEL                                          FGEO    5
      COMMON/GEO/ R12(2),ROE(2),BETAP(2),L(4),GAMA(4),R2P(8),A(4),B(4),  FGEO    6
     *KEY(8),KEYL(4),IER(8)                                              FGEO    7
      COMMON/PLOTO/IPLOT(2),IPRINT                                       FGEO    8
      DIMENSION ALPHA(2)                                                 FGEO    9
C INITIALIZE DATA                                                        FGEO   10
      ALFAC=1.                                                           FGEO   11
      IF(IPASS.EQ.1)ALFAC=10.                                            FGEO   12
      RBT=RB-T                                                           FGEO   13
      IDIR=0                                                             FGEO   14
      DELA=.05                                                           FGEO   15
      IBAD1=0                                                            FGEO   16
      IBAD2=0                                                            FGEO   17
      RFOIL=IFOIL                                                        FGEO   18
      RNOTSV=0.                                                          FGEO   19
      RF=RNOT                                                            FGEO   20
      F=1.                                                               FGEO   21
      C1=2.*3.14159/RFOIL                                                FGEO   22
    5 ALPHA(1)=(90.-180./RFOIL)*3.14159/180.                             FGEO   23
      IF(IPASS.EQ.1)ALPHA(1)=0.025                                       FGEO   24
      ALPHA(2)=ALPHA(1)+DELA*ALPHA(1)                                    FGEO   25
      IF(IPRINT.EQ.0)GO TO 10                                            FGEO   26
      WRITE(61,501)IFOIL,RL,T,RBT,RFF                                    FGEO   27
   10 RNOT=RF                                                            FGEO   28
      IF(IDIR.GE.2)IDIR=0                                                FGEO   29
      IDIR=1                                                             FGEO   30
      IF(IBAD1.EQ.1)IDIR=2                                               FGEO   31
      IF(IBAD2.EQ.2)IDIR=1                                               FGEO   32
C     IF(IDIR.EQ.1)WRITE(61,630)                                         FGEO   33
C     IF(IDIR.EQ.2)WRITE(61,635)                                         FGEO   34
      IF(ALPHA(IDIR).LE..02.OR.ALPHA(IDIR).GE.3.14159265)GO TO 2000      FGEO   35
   11  THETA=RL/RNOT                                                     FGEO   36
      CALL MEMSET(R12(1),IER(8),0.)                                      FGEO   37
      RLF=2.*RNOT*SIN(THETA/2.)                                          FGEO   38
      IF(THETA-(ALPHA(IDIR)+2.*3.14159265/RFOIL))30,30,20                FGEO   39
   20 ALPHA(IDIR)=ALPHA(IDIR)+DELA/(F*ALFAC)*ALPHA(IDIR)                 FGEO   40
      IF(IDIR.GE.2)IDIR=0                                                FGEO   41
      GO TO 10                                                           FGEO   42
   30 R2A=RBT*COS(C1*ALPHA(IDIR))                                        FGEO   43
      R2B=(RBT*COS(C1*ALPHA(IDIR)))**2-(RBT**2-RLF**2)                   FGEO   44
      IF(IPASS.EQ.1.AND.RNOT.NE.RF)GO TO 20                              FGEO   45
      CALL QUAD(R2A,R2B,1,R12,2,IER,NER)                                 FGEO   46
C     WRITE(61,510)ALPHA(IDIR),THETA,RLF,RNOT                            FGEO   47
C     WRITE(61,520)R12                                                   FGEO   48
C     IF(NER.NE.0)WRITE(61,530)IER                                       FGEO   49
C CHECK TO SEE IF R2 VALUES ARE VALID                                    FGEO   50
      DO 31 I=1,2                                                        FGEO   51
      IF(R12(I).GT.0..AND.R12(I).LE.RBT)KEY(I)=I                         FGEO   52
   31 CONTINUE                                                           FGEO   53
      DO 35 I=1,2                                                        FGEO   54
      IF(KEY(I)-1)35,40,40                                               FGEO   55
C     WRITE(61,525)                                                      FGEO   56
   35 CONTINUE                                                           FGEO   57
      RNOT=.99*RNOT                                                      FGEO   58
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                GO TO 11                                                        FGEO       59
             40 K=0                                                             FGEO       60
60              DO 50 I=1,2                                                     FGEO       61
                IF(KEY(I).EQ.0)GO TO 50                                         FGEO       62
                K=K+1                                                           FGEO       63
                ROE(K)=ASIN(R12(I)/RNOT*SIN(C1/2.))                             FGEO       64
             50 CONTINUE                                                        FGEO       65
65           C  WRITE(61,540)ROE                                                FGEO       66
                K=0                                                             FGEO       67
                DO 60 I=1,2                                                     FGEO       68
                IF(KEY(I).EQ.0)GO TO 60                                         FGEO       69
                K=K+1                                                           FGEO       70
70              BETAP(K)=THETA-ROE(K)                                           FGEO       71
                B(K)=(RNOT*COS(BETAP(K)))**2-(RNOT**2-RBT**2)                   FGEO       72
                A(K)=RNOT*COS(BETAP(K))                                         FGEO       73
             60 CONTINUE                                                        FGEO       74
                J=2*K                                                           FGEO       75
75              CALL QUAD(A,B,K,L,J,IER,NER)                                    FGEO       76
             C  WRITE(61,550)L                                                  FGEO       77
             C  IF(NER.NE.0)WRITE(61,530)IER                                    FGEO       78
                IF(2*NER-J)80,70,70                                             FGEO       79
             70 CONTINUE                                                        FGEO       80
80           C NO REAL VALUES OF L EXIST                                        FGEO       81
                RNOT=(1.-.005/F)*RNOT                                           FGEO       82
                GO TO 11                                                        FGEO       83
             80 N=K**2-2*NER                                                    FGEO       84
                K=0                                                             FGEO       85
85              DO 90 I=1,N                                                     FGEO       86
                IF(L(I).LE.0.)KEYL(I)=1                                         FGEO       87
                IF(IER(I).NE.0)GO TO 90                                         FGEO       88
                IF(L(I).LE.0.)GO TO 90                                          FGEO       89
                K=K+1                                                           FGEO       90
90              GAMA(K)=ACOS((-(RNOT)**2+RBT**2+L(I)**2)/(2.*RBT*L(I)))         FGEO       91
             90 CONTINUE                                                        FGEO       92
                IF(K-1)95,96,96                                                 FGEO       93
             95 CONTINUE                                                        FGEO       94
             C NO REAL VALUES OF L                                              FGEO       95
95              RNOT=(1.-.005/F)*RNOT                                           FGEO       96
                GO TO 11                                                        FGEO       97
             96 CONTINUE                                                        FGEO       98
             C  WRITE(61,560)GAMA                                               FGEO       99
                KK=0                                                            FGEO      100
100             DO 100 I=1,N                                                    FGEO      101
                IF(IER(I).NE.0)GOTO 100                                         FGEO      102
                IF(L(I).LE.0.)GO TO 100                                         FGEO      103
                KK=KK+1                                                         FGEO      104
                A(KK)=L(I)*COS(ALPHA(IDIR)+GAMA(KK))                            FGEO      105
105             B(KK)=A(KK)**2-(L(I)**2-RNOT**2)                                FGEO      106
            100 CONTINUE                                                        FGEO      107
            610 FORMAT(1H0,4E11.4,5X,4E11.4)                                    FGEO      108
                J=2*KK                                                          FGEO      109
                CALL QUAD(A,B,KK,R2P,J,IER,NER)                                 FGEO      110
110          C  WRITE(61,570)R2P                                                FGEO      111
             C  IF(NER.NE.0)WRITE(61,530)IER                                    FGEO      112
             C CHECK R2P AGAINST R12                                            FGEO      113
                E=3.*T/F**5                                                     FGEO      114
                ERMIN=100.                                                      FGEO      115
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                      DO 122 LK=1,2                                                    FGEO      116
                      IF(KEY(LK).EQ.0)GO TO 122                                        FGEO      117
                      DO 120 M=1,KK                                                    FGEO      118
                      DO 120 N=1,2                                                     FGEO      119
                      IF(N.EQ.1)I=M                                                    FGEO      120
                      IF(N.EQ.2)I=M+KK                                                 FGEO      121
                      IF(R2P(I).LE.0.)GO TO 120                                        FGEO      122
                      ERR1=ABS(R2P(I)-(R12(LK)+T))                                     FGEO      123
                      ERR2=ABS(R2P(I)-(R12(LK)+T))                                     FGEO      124
                      ERR=AMAX1(ERR1,ERR2)                                             FGEO      125
                      IF(ERR.GT.ERRMIN)GO TO 120                                       FGEO      126
                      ERRMIN=ERR                                                       FGEO      127
                      IR2P=I                                                           FGEO      128
                      IR12=LK                                                          FGEO      129
                      K=0                                                              FGEO      130
                      DO 119 J=1,4                                                     FGEO      131
                      IF(KEYL(J).EQ.1)GO TO 119                                        FGEO      132
                      K=K+1                                                            FGEO      133
                      IF(K-M)119,118,119                                               FGEO      134
                  118 IL=J                                                             FGEO      135
                      GO TO 120                                                        FGEO      136
                  119 CONTINUE                                                         FGEO      137
                  120 CONTINUE                                                         FGEO      138
                  122 CONTINUE                                                         FGEO      139
                      IF(RNOT.EQ.RNOTSV)GO TO 123                                      FGEO      140
                      IF(IPRINT.EQ.0)GO TO 123                                         FGEO      141
                      WRITE(61,641)RNOT                                                FGEO      142
                      WRITE(61,645)                                                    FGEO      143
                      WRITE(61,655)                                                    FGEO      144
                  123 CONTINUE                                                         FGEO      145
                      RNOTSV=RNOT                                                      FGEO      146
                      IF(IPRINT.EQ.0)GO TO 124                                         FGEO      147
                      WRITE(61,650)ALPHA(IDIR),R12(IR12),R2P(IR2P),L(IL),THETA,RLF,    FGEO      148
                     +ERRMIN                                                           FGEO      149
                    124 CONTINUE                                                       FGEO      150
                      IF(R2P(IR2P).LE.R12(IR12)+T+E.AND.R2P(IR2P).GE.R12(IR12)+T-E     FGEO      151
                     +.AND.R2P(IR2P).GT.0.)GO TO 900                                   FGEO      152
                  C VALUES OF R2 DO NOT MATCH                                          FGEO      153
                      IF(F.EQ.1.)GO TO 121                                             FGEO      154
                      F=1.                                                             FGEO      155
                      E=3.*T/F**5                                                      FGEO      156
                      IF(R2P(IR2P).LE.R12(IR12)+T+E.AND.R2P(IR2P).GE.R12(IR12)+T-E.AND. FGEO      157
                     +R2P(IR2P).GT.0.)GO TO 1000                                       FGEO      158
                  130 CONTINUE                                                         FGEO      159
                      IF(IPRINT.EQ.0)GO TO 121                                         FGEO      160
                      WRITE(61,620)                                                    FGEO      161
                  121 RNOT=(1.-.005/F)*RNOT                                            FGEO      162
                      GO TO 11                                                         FGEO      163
                    900 IF(F.EQ.1..AND.IPRINT.NE.0)WRITE(61,620)                       FGEO      164
                  1000 CONTINUE                                                        FGEO      165
                      F=2.                                                             FGEO      166
                      E=3.*T/F**5                                                      FGEO      167
                      IF(R2P(IR2P).LE.R12(IR12)+T+E.AND.R2P(IR2P).GE.R12(IR12)+T-E.AND.R FGEO      168
                     +2P                                                               FGEO      169
                     +(IR2P).GT.0.)GO TO 1100                                          FGEO      170
                      RNOT=(1.-.005/F)*RNOT                                            FGEO      171
                      GO TO 11                                                         FGEO      172
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      1100  CONTINUE                                                          FGEO      173
            WRITE(6,656)                                                      FGEO      174
            WRITE(6,580)                                                      FGEO      175
  175       IF(IPRINT.NE.0)WRITE(6,590)R2P(IR2P),E                            FGEO      176
            WRITE(6,642)RNOT                                                  FGEO      177
            R2=R12(IR12)                                                      FGEO      178
            SA=ASIN(R2/RNOT*SIN(C1/2.))                                       FGEO      179
            IPASS=3                                                           FGEO      180
  180   1111  CONTINUE                                                        FGEO      181
            RETURN                                                            FGEO      182
       2000 CONTINUE                                                          FGEO      183
            IF(IPRINT.EQ.0)GO TO 2001                                         FGEO      184
            WRITE(6,600)                                                      FGEO      185
  185       WRITE(6,640)ALPHA(IDIR)                                           FGEO      186
       2001 CONTINUE                                                          FGEO      187
            RF=(1.-0.605/F)*RF                                                FGEO      188
            IF(RF.GT.1.)GO TO 5                                               FGEO      189
            IBAD2=2                                                           FGEO      190
  190       IF(IDIR.EQ.1)IBAD1=1                                              FGEO      191
            IF(IDIR.EQ.2)IBAD2=2                                              FGEO      192
            IF(IBAD1.EQ.1.AND.IBAD2.EQ.2)GO TO 1111                           FGEO      193
            GO TO 10                                                          FGEO      194
        501 FORMAT(1H0,*FOILS,ARCL,T,RHT,RFF = *,18,3X,4(F10.4,1X))           FGEO      195
  195   510   FORMAT(1H0,*ALPHA,THETA,LF,RNOT = *,4F10.4)                     FGEO      196
        520   FORMAT(1H0,*VALUES OF R2 *,/,1X,2(E11.4,2X))                    FGEO      197
        530   FORMAT(1H ,*THE FOLLOWING ELEMENTS OF THE ABOVE ARRAY ARE IMAINARY FGEO    198
             +*,3X,8(I2,2X))                                                  FGEO      199
        535   FORMAT(1H ,*THIS CALCULATED VALUE OF R2 IS NOT VALID*)          FGEO      200
  200   540   FORMAT(1H0,*VALUES OF ROE *,/,1X,2(E11.4,2X))                   FGEO      201
        550   FORMAT(1H0,*VALUES OF L *,/,1X,4(E11.4,2X))                     FGEO      202
        560   FORMAT(1H0,*VALUES OF GAMMA *,/,1X,4(E11.4,2X))                 FGEO      203
        570   FORMAT(1H0,*VALUES OF R2PRIME */,1X,8(E11.4,2X))                FGEO      204
          580 FORMAT(1H0,*THIS IS A CONVERGED CASE, YOU LUCKY DOG*,/,1X,       FGEO      205
  205      +*FOIL GEOMETRY GIVES THE FOLLOWING VALUES FOR THE ASSEMBLY *      FGEO      206
             +*POSITION.*)                                                    FGEO      207
        590   FORMAT(1H ,*R2=*,E11.4,* +/- *,E11.4)                           FGEO      208
        600   FORMAT(1H0,*NO SOLUTION WITH THESE VALUES*)                     FGEO      209
        620   FORMAT(1H0,132(1H*))                                            FGEO      210
  210   630   FORMAT(1H0,*DECREASING ALPHA*,100(1H*))                         FGEO      211
        635   FORMAT(1H0,*INCREASING ALPHA*,100(1H*))                         FGEO      212
        640   FORMAT(1H0///,1H0,*ALPHA= *,E11.4)                              FGEO      213
          641 FORMAT(1H0///,1H0,*RNOT= *,E11.4)                               FGEO      214
          642 FORMAT(1H0,///,1X,*RADIUS OF CURVATURE AT ASSEMBLY POSITION = *, FGEO      215
  215      +E11.4)                                                          FGEO      216
          645 FORMAT(1H0,18X,*ALPHA*,6X,*R2*,10X,*R2PRIME*,6X,*L*,12X,*THETA* FGEO      217
             +,8X,*LF*,11X,*ERROR*)                                           FGEO      218
        650   FORMAT(1H ,15X,7(E11.4,2X))                                     FGEO      219
        655   FORMAT(1H ,14X,89(1H*))                                         FGEO      220
  220     656 FORMAT(1H0,///,1X,125(1H*),/,1X,*FOIL BEARING ASSEMBLY GEOMETRY*) FGEO      221
            END                                                               FGEO      222
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      SUBROUTINE QUAD(A,B,NV,C,NC,IER,NER)                              FGEO  223
      DIMENSION A(NV),B(NV),C(NC),IER(NC)                               FGEO  224
      CALL MEMSET(IER(1),IER(NC),0)                                     FGEO  225
      NER=0                                                             FGEO  226
      DO 10 L=1,NV                                                      FGEO  227
      IF(B(L))5,10,10                                                   FGEO  228
    5 IER(L)=L                                                          FGEO  229
      NER=NER+1                                                         FGEO  230
      B(L)=-B(L)                                                        FGEO  231
   10 B(L)=SQRT(B(L))                                                   FGEO  232
      K=1                                                               FGEO  233
  100 FORMAT(1H0,4E11.4,5X,4F11.4)                                      FGEO  234
      DO 20 I=1,2                                                       FGEO  235
      DO 20 J=1,NV                                                      FGEO  236
   15 IF(J.EQ.IER(J))GO TO 20                                           FGEO  237
      C(K)=A(J)+(-1.)**I*B(J)                                           FGEO  238
   20 K=K+1                                                             FGEO  239
      RETURN                                                            FGEO  240
      END                                                               FGEO  241
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      SUBROUTINE SHAFTBC(RP,RINIT,RFINAL,DELR,RMINF,KEC,ICHNG)                  SHAFTBC     2
      COMMON/FOILEY/IFOIL,NODFL                                                 SHAFTBC     3
      COMMON/PDEL/R(160),RF(162)                                                SHAFTBC     4
      COMMON/BODISP/NODISP,I1DDSP(160),I2DDSP(160)                              SHAFTBC     5
      COMMON/SET/NODSET(160),NNODST                                             SHAFTBC     6
      COMMON/BCP/KODEBC(160),FDZ(160),FDR(160)                                  SHAFTBC     7
      COMMON/PLOTQ/IPLOT(2),IPRINT,MPRINT                                       SHAFTBC     8
      DIMENSION RP(1)                                                           SHAFTBC     9
C                                                                               SHAFTBC    10
C     FIND NODE WITHMINIMUM RADIUS                                              SHAFTBC    11
      RMINF=RF(1)                                                               SHAFTBC    12
      DO 1000 K=1,IFOIL                                                         SHAFTBC    13
      I1=(K-1)*NODFL+2                                                          SHAFTBC    14
      I2=K*NODFL                                                                SHAFTBC    15
      I3=(K-1)*NODFL+1                                                          SHAFTBC    16
      RMIN=RF(I3)                                                               SHAFTBC    17
      IMIN=I3                                                                   SHAFTBC    18
      DO 110 I=I1,I2                                                            SHAFTBC    19
      IF(RF(I).GE.RMIN)GO TO 110                                                SHAFTBC    20
      IMIN=I                                                                    SHAFTBC    21
      RMIN=RF(I)                                                                SHAFTBC    22
  110 CONTINUE                                                                  SHAFTBC    23
      IF(RMIN.GE.RFINAL)GO TO 1000                                              SHAFTBC    24
      IF(RINIT.NE.0..AND.RMIN.GE.RINIT)GO TO 1000                               SHAFTBC    25
      RP=RINIT                                                                  SHAFTBC    26
      IF(RINIT.EQ.0.)RP=RMIN+DELR                                               SHAFTBC    27
C     CONSTRAIN NODE                                                            SHAFTBC    28
C       CHECK FOR DEP. NODE                                                     SHAFTBC    29
      DO 200 N=1,NODISP                                                         SHAFTBC    30
      IF(IMIN.NE.I1DDSP(N))GO TO 200                                            SHAFTBC    31
      IMIN=IABS(I2DDSP(N))                                                      SHAFTBC    32
  200 CONTINUE                                                                  SHAFTBC    33
      NNODST=NNODST+1                                                           SHAFTBC    34
      NODSET(IMIN)=IMIN                                                         SHAFTBC    35
      IF(IPRINT.NE.0.OR.MPRINT.EQ.1)WRITE(61,800)IMIN                           SHAFTBC    36
  800 FORMAT(1H ,*NODE *,I3,* SET*)                                             SHAFTBC    37
      CALL PACK60(KODEBC(IMIN),1,2)                                             SHAFTBC    38
      IF(RMIN.GE.RMINF)GO TO 1000                                               SHAFTBC    39
      RMINF=RMIN                                                                SHAFTBC    40
 1000 CONTINUE                                                                  SHAFTBC    41
      RETURN                                                                    SHAFTBC    42
C                                                                               SHAFTBC    43
C                                                                               SHAFTBC    44
      ENTRY SHAFT2                                                              SHAFTBC    45
C     FIND NODES WITH MINIMUM RADIUS                                            SHAFTBC    46
      ICHNG=0                                                                   SHAFTBC    47
      QP=RP(1)                                                                  SHAFTBC    48
      IF(KEC.EQ.0)CALL MEMSET(RP(1),RP(160),QP)                                 SHAFTBC    49
      DO 1500 J=1,IFOIL                                                         SHAFTBC    50
      I1=(J-1)*NODFL+NODFL/2+1                                                  SHAFTBC    51
      I2=J*NODFL                                                                SHAFTBC    52
      I3=(J-1)*NODFL+1                                                          SHAFTBC    53
      RMIN=0.                                                                   SHAFTBC    54
      IMIN=I1                                                                   SHAFTBC    55
      IMIND=I1                                                                  SHAFTBC    56
      DO 1500 I=I1,I2                                                           SHAFTBC    57
      RESR=RF(I)-RP(I)                                                          SHAFTBC    58
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                      IF(RESP.GE.0)GO TO 1500                                   SHAFTBC    59
                      IF(RESP.GE.RMIN)GO TO 1500                                SHAFTBC    60
                60    K=I                                                       SHAFTBC    61
                C      CHECK FOR DEP NODE                                       SHAFTBC    62
                      DO 1200 N=1,NODISP                                        SHAFTBC    63
                      IF(I.EQ.I1DDSP(N))K=IABS(I2DDSP(N))                       SHAFTBC    64
                1200  CONTINUE                                                  SHAFTBC    65
                65    IMIN=K                                                    SHAFTBC    66
                      IMIND=I                                                   SHAFTBC    67
                      RMIN=RESP                                                 SHAFTBC    68
                1500  CONTINUE                                                  SHAFTBC    69
                      IF(IPRINT.NE.0)WRITE(61,1031)IMIN,NODSET(IMIN)            SHAFTBC    70
                70    1031  FORMAT(1H0,*NODSET(*,I3,*)=*,I3)                   SHAFTBC    71
                      IF(NODSET(IMIN).EQ.-IMIN)GO TO 1600                       SHAFTBC    72
                      IF(RF(IMIND).GE.RP(IMIND))GO TO 1600                      SHAFTBC    73
                      ICHNG=1                                                   SHAFTBC    74
                      NNODST=NNODST+1                                           SHAFTBC    75
                75    NODSET(IMIN)=-IMIN                                        SHAFTBC    76
                      IF(IPRINT.NE.0.OR.MPRINT.EQ.1)WRITE(61,800)IMIN           SHAFTBC    77
                      CALL PACK60(KODEBC(IMIN),1,2)                             SHAFTBC    78
                1600  CONTINUE                                                  SHAFTBC    79
                      IF(REC.EQ.1)GO TO 1510                                    SHAFTBC    80
                80    IF(RP.GT.RFINAL)RP=RFINAL                                 SHAFTBC    81
                1510  CONTINUE                                                  SHAFTBC    82
                      RETURN                                                    SHAFTBC    83
                      END                                                       SHAFTBC    84
```

CARD NR. SEVERITY DETAILS DIAGNOSIS OF PROBLEM

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  25    I     RP      ARRAY NAME OPERAND NOT SUBSCRIPTED, FIRST ELEMENT WILL BE USED.
  26    I     RP      ARRAY NAME OPERAND NOT SUBSCRIPTED, FIRST ELEMENT WILL BE USED.
  48    I     RP      ARRAY REFERENCE OUTSIDE DIMENSION BOUNDS.
  80    I     RP      ARRAY NAME OPERAND NOT SUBSCRIPTED, FIRST ELEMENT WILL BE USED.
  80    I     RP      ARRAY NAME OPERAND NOT SUBSCRIPTED, FIRST ELEMENT WILL BE USED.
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82500

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      OVERLAY(ISOFR1,6,1)                                                    ASSMBG     2
      PROGRAM ASSMBG                                                         ASSMBG     3
C                                                                            ASSMBG     4
C     GENERAL ASSEMBLY ROUTINE TO COMBINE ELEMENT STIFFNESS MATRICES         ASSMBG     5
C         INTO BLOCKS FOR SOLUTION BY SUBROUTINE SYMSOL                      ASSMBG     6
C     UPPER SYMMETRIC HALF OF SYSTEM MATRIX WILL BE ASSEMBLED, PLUS          ASSMBG     7
C           LOWER HALF OF THOSE BLOCKS ON THE DIAGONAL                       ASSMBG     8
C                                                                            ASSMBG     9
C     NS    = ORDER OF BLOCK SIZE FOR SYMSOL                                 ASSMBG    10
C     NN    = NO. OF BLOCKS ON DIAGONAL                                      ASSMBG    11
C     MM    = NO. OF BLOCKS PER ROW                                          ASSMBG    12
C             MM .LE. NN                                                     ASSMBG    13
C     NELEM= NO. OF ELEMENTS                                                 ASSMBG    14
C     NODES= NO. OF NODES                                                    ASSMBG    15
C     NNPE = NO. OF NODES PER ELEMENT                                        ASSMBG    16
C     NDOF = NO. OF DEGREES OF FREEDOM PER NODE                              ASSMBG    17
C     LUE  = UNIT NUMBER WHERE ELEMENT STIFFNESS MATRICES ARE STORED         ASSMBG    18
C     LUK  = UNIT NUMBER WHERE BLOCKS ARE TO BE STORED                       ASSMBG    19
C     NSTF = NNPE * NDOF = ORDER OF ELEMENT STIFFNESS MATRICES               ASSMBG    20
C     NEQ= NODES * NDOF = TOTAL NO. OF EQUATIONS IN SYSTEM                   ASSMBG    21
C     NN= (NEQ + NS - 1 ) / NS                                               ASSMBG    22
C     NW= MAX. DIFFERENCE BETWEEN NODE NOS. OF AN ELEMENT                    ASSMBG    23
C     NBAND= (NW + 1 ) * NDOF = MATRIX HALF-BAND WIDTH                       ASSMBG    24
C     FOR UNBANDED SYSTEM, FOLLOWING FORMULA GIVES MM= NN+1, RESET MM=NN     ASSMBG    25
C     MM= (NBAND - NDOF - 1 ) / NS + 2                                       ASSMBG    26
C     NRECRD= ( NN * ( NN + 1 ) ) / 2 = NO. OF POSSIBLE BLOCKS (RECORDS)     ASSMBG    27
C     NOTE-- UNLESS MM= NN , MOST BLOCKS WILL BE ALL 0. AND WILL             ASSMBG    28
C              NOT  BE WRITTEN TO DISK OR ACCESSED BY SYMSOL                 ASSMBG    29
C     NOTE-- NS MUST BE A MULTIPLE OF NDOF                                   ASSMBG    30
C                                                                            ASSMBG    31
C*    GIVEN NODES= 450 MAX., AND NDOF= 6 MAX., (AND ALLOWING FOR NDOF=2      ASSMBG    32
C*         OR NDOF=3) , THEN NS= 36 MINIMIZES THE STORAGE REQUIRED FOR       ASSMBG    33
C*         SYMSOL                                                            ASSMBG    34
C                                                                            ASSMBG    35
C     ARRAYS MUST HAVE DIMENSIONS--                                          ASSMBG    36
C         A(NS,NS), LM(NNPE), NB(NELEM,NNPE),     S(NSTF,NSTF)               ASSMBG    37
C         KRECRD(NRECRD)                                                     ASSMBG    38
C                                                                            ASSMBG    39
      COMMON/RCP/KODEBC(160),FDZ(160),FDR(160)                               ASSMBG    40
      COMMON /SYMSL1/ A(12,12)                                               ASSMBG    41
      COMMON/SYMSL2/S(6,6)                                                   ASSMBG    42
      COMMON /SYMSL3/ B(12)                                                  ASSMBG    43
      DIMENSION C(12,12)                                                     ASSMBG    44
      DIMENSION LM(4),U(2)                                                   ASSMBG    45
      COMMON/PDDISP/NDDISP,I1DDSP(160),I2DDSP(160),DDISPY(160),DDISPX(16     ASSMBG    46
     +0)                                                                     ASSMBG    47
      COMMON/CURRMZ/DUM(198),NB(145,2)                                       ASSMBG    48
      COMMON/NSX/NS                                                          ASSMBG    49
      COMMON/FOILLY/IFOIL,NODFL                                              ASSMBG    50
      COMMON/SYMSOL/NN,MM,NNPE,NDOF,NVECT,NODES,NELEM,NW,LUT,LUK,LUE,        ASSMBG    51
     +LUR,INDEX3(41),INDEX7(146),INDEX17(821),INDEX19(41),KRECRD(820),       ASSMBG    52
     +NEQ                                                                    ASSMBG    53
C                                                                            ASSMBG    54
      NRCD(I,J)=((I+J)*(I+J-1))/2-J+1                                        ASSMBG    55
C                                                                            ASSMBG    56
C                                                                            ASSMBG    57
C                                                                            ASSMBG    58
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      C     IF THERE ARE CYCLO OR DUISP NODAL PAIRS, THEY MUST BE ORDERED SO                ASSMBG     59
      C           THAT  I1XXXX .LT. I2XXXX , AND, ANY LOADING ON NODE I1XXXX                ASSMBG     60
      C           MUST BE ADDED TO I2XXXX.  THIS IS ASSUMED TO HAVE BEEN DONE               ASSMBG     61
      C           PRIOR TO ENTRY HERE.                                                      ASSMBG     62
      C     SET DEPENDENT FREEDOMS TO BE RESTRAINED FROM SYSTEM                             ASSMBG     63
            12 IF (NDDISP .EQ. 0) GO TO 15                                                  ASSMBG     64
               DO 14 I=1,NDDISP                                                             ASSMBG     65
               N= IABS(I1DDSP(I))                                                           ASSMBG     66
               IF(N.EQ.0)GO TO 14                                                           ASSMBG     67
               IF (I1DDSP(I) .GT. 0) GO TO 13                                               ASSMBG     68
               CALL PACK60 (KODEBC(N), 1, 1 )                                               ASSMBG     69
               FDZ(N)= 0.                                                                   ASSMBG     70
            13 IF (I2DDSP(I) .GT. 0) GO TO 14                                               ASSMBG     71
               CALL PACK60 (KODEBC(N), 1, 2 )                                               ASSMBG     72
               FDR(N)= 0.                                                                   ASSMBG     73
            14 CONTINUE                                                                     ASSMBG     74
            15 CONTINUE                                                                     ASSMBG     75
      C                                                                                     ASSMBG     76
            BIGNO=1.E30                                                                     ASSMBG     77
            NSIZE=NS*NS                                                                     ASSMBG     78
      C     NOTE-- NNPE= 4 HERE, WHETHER THERE ARE TRIANGLES OR NOT                         ASSMBG     79
            NSTF=NDOF*NNPE                                                                  ASSMBG     80
      C     UNPACK NODE NOS. OF ELEMENTS TO NB ARRAY ONCE                                   ASSMBG     81
            NSTF2=NSTF*NSTF                                                                 ASSMBG     82
      C     NUEL IS THE NO. OF NODES WITHIN ONE BLOCK, LESS 1                               ASSMBG     83
            NUEL=NS/NDOF-1                                                                  ASSMBG     84
            NR1=1                                                                           ASSMBG     85
      C* * SET FLAGS FOR ZERO BLOCKS                                                         ASSMBG     86
            CALL MEMSET(KRECRD,KRECRD(820),0)                                               ASSMBG     87
            ISHIFT=0                                                                        ASSMBG     88
      C     NELINC IS THE NUMBER OF THE ELEMENT STIFFNESS IN CORE                           ASSMBG     89
            NELINC=0                                                                        ASSMBG     90
      C     INITIALIZE BLOCK                                                              ASSMBG     91
            DO 40 I1=1,NSIZE                                                                ASSMBG     92
         40 A(I1)=0.                                                                        ASSMBG     93
            KMM=MM                                                                          ASSMBG     94
            NNMMP1=NN-MM+1                                                                  ASSMBG     95
            DO 340 I=1,NN                                                                   ASSMBG     96
            NR2=NR1+NUEL                                                                    ASSMBG     97
         41 FORMAT(1H0,*I=*,I3,5X,*NR1=*,I3,5X,*NR2=*,I3)                                   ASSMBG     98
            NC1=NR1                                                                         ASSMBG     99
            JSHIFT=ISHIFT                                                                   ASSMBG    100
            IF (I.GT.NNMMP1) KMM=KMM-1                                                      ASSMBG    101
            DO 50 K=1,NS                                                                    ASSMBG    102
         50 B(K)=0.                                                                         ASSMBG    103
            DO 210 J=1,KMM                                                                  ASSMBG    104
            NC2=NC1+NUEL                                                                    ASSMBG    105
      C     NIK IS THE BLOCK NUMBER (AND RECORD NO. ON DISK)                                ASSMBG    106
            NIK=NRCD(I,J)                                                                   ASSMBG    107
            NIK1=MOD(NIK,60)                                                                ASSMBG    108
            IF (NIK1.EQ.0) NIK1=60                                                          ASSMBG    109
            NIK2=(NIK-1)/60+1                                                               ASSMBG    110
         42 FORMAT(1H0,*J=*,I3,5X,*NIK=*,I3,5X,*NIK1=*,I3,5X,*NIK2=*,I3)                    ASSMBG    111
            DO 130 K=1,NELEM                                                                ASSMBG    112
      C     CHECK IF ELEMENT K WILL CONTRIBUTE ANYTHING TO THIS BLOCK                       ASSMBG    113
            IFLAG=0                                                                         ASSMBG    114
            JFLAG=0                                                                         ASSMBG    115
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                      DO 60 L=1,NNPE                                          ASSMBG  116
                      LL=NB(K,L)                                              ASSMBG  117
                      IF (LL.GE.NR1.AND.LL.LE.NR2) IFLAG=1                    ASSMBG  118
                      IF (LL.GE.NC1.AND.LL.LE.NC2) JFLAG=1                    ASSMBG  119
                   60 CONTINUE                                                ASSMBG  120
                   61 FORMAT(1H0,*IFLAG=*,I3,3X,*JFLAG=*,I3)                  ASSMBG  121
                      IF (IFLAG*JFLAG.NE.2) GO TO 130                         ASSMBG  122
                C     SET FLAG FOR THIS BLOCK NOT BEING ALL ZEROS             ASSMBG  123
                   62 FORMAT(1H ,*LL=*,I3,5X,*SET FLAG FOR THIS BLOCK NOT ALL 0)S*)  ASSMBG  124
                      CALL PACK60 (KRECRD(NTK2),1,NTK1)                       ASSMBG  125
                      DO 70 L=1,NNPE                                          ASSMBG  126
                   70 LM(L)=NDOF*(NB(K,L)-1)                                  ASSMBG  127
                      IF (K.EQ.NELINC) GO TO 80                               ASSMBG  128
                      NELINC=K                                                ASSMBG  129
                C     READ ELEMENT STIFFNESS MATRIX FROM DISK                 ASSMBG  130
                   44 FORMAT(1H0,*S MATRIX READ IN HERE*)                     ASSMBG  131
                      CALL READMS (LUE,S,NSTF2,K)                             ASSMBG  132
                C     ADD IN ELEMENT STIFFNESS MATRIX                         ASSMBG  133
                   80 IIS=1                                                   ASSMBG  134
                      DO 120 II=1,NNPE                                        ASSMBG  135
                C **  CHECK FOR TRIANGLE                                      ASSMBG  136
                      IF (LM(II).LT.0) GO TO 120                              ASSMBG  137
                      IIA=LM(II)-ISHIFT+1                                     ASSMBG  138
                C     CHECK IF ROW OF BLOCK IS VALID                          ASSMBG  139
                      IF (IIA.LT.1.OR.IIA.GT.NS) GO TO 120                    ASSMBG  140
                      JJS=1                                                   ASSMBG  141
                      DO 110 JJ=1,NNPE                                        ASSMBG  142
                C **                                                          ASSMBG  143
                      IF (LM(JJ).LT.0) GO TO 110                              ASSMBG  144
                      JJA=LM(JJ)-JSHIFT+1                                     ASSMBG  145
                C     CHECK IF COL OF BLOCK IS VALID                          ASSMBG  146
                      IF (JJA.LT.1.OR.JJA.GT.NS) GO TO 110                    ASSMBG  147
                      III=IIA                                                 ASSMBG  148
                      KKK=IIS                                                 ASSMBG  149
                      DO 100 KK=1,NDOF                                        ASSMBG  150
                      JJJ=JJA                                                 ASSMBG  151
                      LLL=JJS                                                 ASSMBG  152
                      DO 90 LL=1,NDOF                                         ASSMBG  153
                      A(III,JJJ)=A(III,JJJ)+S(KKK,LLL)                        ASSMBG  154
                      LLL=LLL+1                                               ASSMBG  155
                   90 JJJ=JJJ+1                                               ASSMBG  156
                      KKK=KKK+1                                               ASSMBG  157
                  100 III=III+1                                               ASSMBG  158
                  110 JJS=JJS+NDOF                                            ASSMBG  159
                  120 IIS=IIS+NDOF                                            ASSMBG  160
                  130 CONTINUE                                                ASSMBG  161
                C     BLOCK IS COMPLETE WITH RESPECT TO ELEMENTAL STIFFNESS   ASSMBG  162
                C     CHECK FOR NON-ZERO BLOCK                                ASSMBG  163
                      CALL UNPCK60 (KRECRD(NTK2),K,NTK1)                      ASSMBG  164
                  131 FORMAT(1H0,*K=*,I3)                                     ASSMBG  165
                      IF (K.EQ.0) GO TO 200                                   ASSMBG  166
                C     CHECK FOR DIAGONAL BLOCK                                ASSMBG  167
                      IF (J.EQ.1) GO TO 140                                   ASSMBG  168
                      GO TO 180                                               ASSMBG  169
                C     CHECK DIAGONAL ELEMENTS (THIS BLOCK MAY NOT BE FULL)    ASSMBG  170
                  140 DO 150 K=1,NS                                           ASSMBG  171
                      IF (A(K,K).EQ.0.) A(K,K)=1.                             ASSMBG  172
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  150 CONTINUE                                                          ASSMBG  173
C     INCREASE DIAGONAL TERM FOR SPECIFIED DISPLACEMENTS                ASSMBG  174
C --- NOTE-- MULTIPLY BY BIGNO (NOT ADD) TO ALLOW RECOVERY OF TRUE      ASSMBG  175
C           STIFFNESS TERM IN CYCLO OR DDISP HANDLING LATER             ASSMBG  176
      LL=1                                                              ASSMBG  177
      DO 175 L=NR1,NR2                                                  ASSMBG  178
      IF (L.GT.NODES) GO TO 180                                         ASSMBG  179
      CALL UNPCK60 (KODEBC(L),KODEZ,1)                                  ASSMBG  180
      IF (KODEZ.EQ.0) GO TO 160                                         ASSMBG  181
      A(LL,LL)= A(LL,LL) * BIGNO                                        ASSMBG  182
  160 LL=LL+1                                                           ASSMBG  183
      CALL UNPCK60 (KODEBC(L),KODER,2)                                  ASSMBG  184
  165 FORMAT(1H0,*KODER= *,I3,* NODE= *,I3)                             ASSMBG  185
      IF (KODER.EQ.0) GO TO 170                                         ASSMBG  186
      A(LL,LL)= A(LL,LL) * BIGNO                                        ASSMBG  187
  170 LL=LL+1                                                           ASSMBG  188
      CALL UNPCK60(KODEBC(L),KODEM,3)                                   ASSMBG  189
      IF(KODEM.EQ.0)GO TO 175                                           ASSMBG  190
      A(LL,LL)=A(LL,LL)*BIGNO                                           ASSMBG  191
  175 LL=LL+1                                                           ASSMBG  192
  180 CALL WRITO(LUK,A,NSIZE,NTK)                                       ASSMBG  193
  181 FORMAT(1H ,*NTK=*,I4)                                             ASSMBG  194
C     INITIALIZE BLOCK                                                  ASSMBG  195
      DO 190 K=1,NSIZE                                                  ASSMBG  196
  190 A(K)=0.                                                           ASSMBG  197
  200 JSHIFT=JSHIFT+NS                                                  ASSMBG  198
  210 NC1=NC2+1                                                         ASSMBG  199
C     CHECK IF ELEMENT K WILL CONTRIBUTE TO THIS ELEMENT BLOCK          ASSMBG  200
C      LOOP 280 REMOVED BECAUSE ELEMENTS DO NOT HAVE ELEMENT LOAD       ASSMBG  201
C    * VECTORS, D. HAWKINS.                                             ASSMBG  202
  280 CONTINUE                                                          ASSMBG  203
C     ADD APPLIED FORCES , SET UP SPECIFIED DISPLACEMENTS, FOR BLOCK    ASSMBG  204
      LL=1                                                              ASSMBG  205
      DO 321 L=NR1,NR2                                                  ASSMBG  206
      IF (L.GT.NODES) GO TO 330                                         ASSMBG  207
      CALL UNPCK60 (KODEBC(L),KODEZ,1)                                  ASSMBG  208
      IF (KODEZ.EQ.0) GO TO 290                                         ASSMBG  209
      GO TO 300                                                         ASSMBG  210
  290 B(LL)=B(LL)+FDZ(L)                                                ASSMBG  211
  300 LL=LL+1                                                           ASSMBG  212
      CALL UNPCK60 (KODEBC(L),KODER,2)                                  ASSMBG  213
      IF (KODER.EQ.0) GO TO 310                                         ASSMBG  214
      GO TO 320                                                         ASSMBG  215
  310 B(LL)=B(LL)+FDR(L)                                                ASSMBG  216
  320 LL=LL+1                                                           ASSMBG  217
      CALL UNPCK60(KODEBC(L),KODEM,3)                                   ASSMBG  218
      IF(KODEM.EQ.0)GO TO 311                                           ASSMBG  219
      GO TO 321                                                         ASSMBG  220
  311 B(LL)=B(LL)                                                       ASSMBG  221
  321 LL=LL+1                                                           ASSMBG  222
  330 CALL WRITLOB(LUK,B,NS,1,1)                                        ASSMBG  223
      ISHIFT=ISHIFT+NS                                                  ASSMBG  224
  340 NR1=NR2+1                                                         ASSMBG  225
C                                                                       ASSMBG  226
C     CHECK FOR CYCLO OR DDISP                                          ASSMBG  227
C                                                                       ASSMBG  228
      NDEL1=NDEL+1                                                      ASSMBG  229
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      705 IF (NDDISP .EQ. 0) GO TO 890                                  ASSMBG  230
230   706 IWHICH= 1                                                     ASSMBG  231
          KOUNT= 0                                                      ASSMBG  232
      710 KOUNT= KOUNT + 1                                              ASSMBG  233
          IF (KOUNT .GT. NDDISP) GO TO 890                              ASSMBG  234
          IZEROS=0                                                      ASSMBG  235
235       N1= IABS(I1DDSP(KOUNT))                                       ASSMBG  236
          IF(N1.EQ.0)GO TO 870                                          ASSMBG  237
          N2= IABS(I2DDSP(KOUNT))                                       ASSMBG  238
          DDX= 0.                                                       ASSMBG  239
          KCYODD= 0                                                     ASSMBG  240
240       IF ( I1DDSP(KOUNT) .GT. 0) GO TO 715                          ASSMBG  241
          KCYODD= 1                                                     ASSMBG  242
          DDX= DDISPX(KOUNT)                                            ASSMBG  243
          IF (DDX .NE. 0.) IZEROS= 1                                    ASSMBG  244
      715 DDY= 0.                                                       ASSMBG  245
245       IF (I2DDSP(KOUNT) .GT. 0) GO TO 720                           ASSMBG  246
          KCYODD= KCYODD + 2                                            ASSMBG  247
          DDY= DDISPY(KOUNT)                                            ASSMBG  248
          IF (DDY .NE. 0.) IZEROS= 1                                    ASSMBG  249
C     NODAL PAIR (N1,N2).  N1 .LT. N2   N1 IS DEPENDENT AND ONE OR BOTH ASSMBG  250
C          (KCYODD=3) FREEDOMS WILL BE DROPPED FROM SYSTEM.             ASSMBG  251
250   720 NR= (N1 - 1) / NDEL1 + 1                                      ASSMBG  252
          NC= NR                                                        ASSMBG  253
          ICOL= N1 * NDOF - (NR - 1) * NS                               ASSMBG  254
          ICOL=ICOL-1                                                   ASSMBG  255
255       ICOLM1= ICOL - 1                                              ASSMBG  256
          NR1= (N2 - 1) / NDEL1 + 1                                     ASSMBG  257
          ICOL1= N2 * NDOF - (NR1 -1) * NS                              ASSMBG  258
          ICOL1=ICOL1-1                                                 ASSMBG  259
          ICOLIM1= ICOL1 - 1                                            ASSMBG  260
260       JDEL= NR1 - NR                                                ASSMBG  261
C     CHECK FOR NON-ZERO DDISPS                                         ASSMBG  262
          IF ( IZEROS .EQ. 0) GO TO 970                                 ASSMBG  263
C     CALC. FORCES DUE TO NON-ZERO DDISPS                               ASSMBG  264
          DO 930 J=1,NR                                                 ASSMBG  265
265       NTK= NRCD(NR,J)                                               ASSMBG  266
          NTK1= MOD(NTK,60)                                             ASSMBG  267
          IF (NTK1 .EQ. 0) NTK1= 60                                     ASSMBG  268
          NTK2= (NTK - 1) / 60 + 1                                      ASSMBG  269
          CALL UNPCK60 (KRECRD(NTK2), L, NTK1 )                         ASSMBG  270
270       IF (L .EQ. 0) GO TO 920                                       ASSMBG  271
          CALL READMS (LUK, C, NSIZE, NTK )                             ASSMBG  272
C     REMOVE BIGNO ON DIAGONAL BLOCK                                    ASSMBG  273
          IF (J .GT. 1) GO TO 900                                       ASSMBG  274
          IF (KCYODD .NE. 2 ) C(ICOLM1,ICOLM1)= C(ICOLM1,ICOLM1) / BIGNO ASSMBG  275
275       IF (KCYODD .NE. 1 ) C(ICOL,ICOL)= C(ICOL,ICOL) / BIGNO        ASSMBG  276
C     PICK UP LOAD VECTOR, MODIFY, AND REWRITE                          ASSMBG  277
      900 CALL READLOR(LUR,B,NS,NR)                                     ASSMBG  278
          DO 910 N=1,NS                                                 ASSMBG  279
                              B(N)= B(N) - C(N,ICOLM1) * DDX - C(N,ICOL) *DDY ASSMBG  280
280   910 CONTINUE                                                      ASSMBG  281
C     REWRITE BLOCK IN PLACE                                            ASSMBG  282
          CALL WRITLOR(LUR,B,NS,NR,1)                                   ASSMBG  283
      920 NR= NR - 1                                                    ASSMBG  284
          IF ( NR .EQ. 0) GO TO 935                                     ASSMBG  285
285       930 CONTINUE                                                  ASSMBG  286
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                  935 NR= NC                                                                    ASSMBG  287
                      IF (NC .EQ. NN) GO TO 970                                                 ASSMBG  288
                      DO 950 J=2,MM                                                             ASSMBG  289
                      NTK= NRCD(NR,J)                                                           ASSMBG  290
                      NTK1= MOD(NTK,60)                                                         ASSMBG  291
      290             IF (NTK1 .EQ. 0) NTK1= 60                                                 ASSMBG  292
                      NTK2= (NTK - 1) / 60 + 1                                                  ASSMBG  293
                      CALL UNPCK60  (KRECRD(NTK2), L, NTK1)                                     ASSMBG  294
                      NC= NC + 1                                                                ASSMBG  295
      295             IF (L .EQ. 0) GO TO 940                                                   ASSMBG  296
                      CALL READMS (LUK, C, NSIZE, NTK )                                         ASSMBG  297
                C     PICK UP LOAD VECTOR, MODIFY, REWRITE                                      ASSMBG  298
                      CALL READLUR(LUR,B,NS,NC)                                                 ASSMBG  299
                      DO 937 N=1,NS                                                             ASSMBG  300
      300                             B(N)= B(N) - C(ICOLM1,N)*DDX -C(ICOL,N)*DDY               ASSMBG  301
                  937 CONTINUE                                                                  ASSMBG  302
                      CALL WRITLUR(LUR,B,NS,NC,1)                                               ASSMBG  303
                  940 IF ( NC .EQ. NN) GO TO 960                                                ASSMBG  304
                  950 CONTINUE                                                                  ASSMBG  305
                  960 NC= NR                                                                    ASSMBG  306
      305         970 CONTINUE                                                                  ASSMBG  307
                C     ADD ROWS AND COLUMNS FOR N1 TO THOSE FOR N2  (** ONLY FOR NDOF=2)         ASSMBG  308
                C     FIRST, COLUMN OF BLOCKS, STARTING AT DIAGONAL BLOCK                       ASSMBG  309
                      DO 760 J=1,MM                                                             ASSMBG  310
      310       C     PICK UP DEPENDENT BLOCK                                                   ASSMBG  311
                      NTK= NRCD(NR,J)                                                           ASSMBG  312
                      NTK1= MOD(NTK,60)                                                         ASSMBG  313
                      IF (NTK1 .EQ. 0) NTK1= 60                                                 ASSMBG  314
                      NTK2= (NTK - 1) / 60 + 1                                                  ASSMBG  315
      315             CALL UNPCK60 (KRECRD(NTK2), L, NTK1 )                                     ASSMBG  316
                      IF (L .EQ. 0) GO TO 755                                                   ASSMBG  317
                      CALL READMS (LUK, C, NSIZE, NTK )                                         ASSMBG  318
                C     REMOVE BIGNO ON DIAGONAL BLOCK                                            ASSMBG  319
                      IF (J .GT. 1) GO TO 735                                                   ASSMBG  320
      320             IF (KCYODD .NE. 2 ) C(ICOLM1,ICOLM1)= C(ICOLM1,ICOLM1) / BIGNO            ASSMBG  321
                      IF (KCYODD .NE. 1 ) C(ICOL,ICOL)= C(ICOL,ICOL) / BIGNO                    ASSMBG  322
                C     PICK UP INDEPENDENT BLOCK                                                 ASSMBG  323
                  735 JJ= J + JDEL                                                              ASSMBG  324
                      NTKI= NRCD(NR,JJ)                                                         ASSMBG  325
      325             NTKI1= MOD(NTKI,60)                                                       ASSMBG  326
                      IF (NTKI1 .EQ. 0) NTKI1= 60                                               ASSMBG  327
                      NTKI2= (NTKI - 1) / 60 + 1                                                ASSMBG  328
                      CALL UNPCK60 ( KRECRD(NTKI2), L, NTKI1 )                                  ASSMBG  329
                      IF (L .EQ. 0) GO TO 740                                                   ASSMBG  330
      330             CALL READMS (LUK, A, NSIZE, NTKI )                                        ASSMBG  331
                      IBEFOR= 1                                                                 ASSMBG  332
                      GO TO 745                                                                 ASSMBG  333
                  740 CALL MEMSET ( A, A(NSIZE), 0. )                                           ASSMBG  334
                      IBEFOR= 0                                                                 ASSMBG  335
      335             CALL PACK60 ( KRECRD(NTKI2), 1, NTKI1 )                                   ASSMBG  336
                  745 IF (J .GT. 1) GO TO 748                                                   ASSMBG  337
                      IF (JDEL .NE. 0) GO TO 747                                                ASSMBG  338
                C     BOTH NODES ARE IN THE SAME BLOCK, ALSO ADD ROWS                           ASSMBG  339
                      DO 746 N=1,NS                                                             ASSMBG  340
      340             IF (KCYODD .NE. 2) A(ICOLM1,N)= A(ICOLM1,N) + C(ICOLM1,N)                 ASSMBG  341
                      IF (KCYODD .NE. 1) A(ICOL1,N)= A(ICOL1,N) + C(ICOL,N)                     ASSMBG  342
                C     MAKE SAME CHANGES TO C BEFORE COLS ARE ADDED                              ASSMBG  343
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                C(ICOLIM1,N)= A(ICOLIM1,N)                                        ASSMBG   344
                C(ICOLI  ,N)= A(ICOLI  ,N)                                        ASSMBG   345
345           746 CONTINUE                                                        ASSMBG   346
                GO TO 748                                                         ASSMBG   347
              C     SAVE TERMS TO BE ADDED TO DIAGONAL AREA LATER                 ASSMBG   348
              747 SAV11= A(ICOLM1,ICOLIM1)                                        ASSMBG   349
                SAV12= A(ICOLM1,ICOLI)                                            ASSMBG   350
350             SAV21= A(ICOL,ICOLIM1)                                            ASSMBG   351
                SAV22= A(ICOL,ICOLI)                                              ASSMBG   352
              C     ADD COLS.                                                     ASSMBG   353
              748 DO 750 N=1,NS                                                   ASSMBG   354
                IF (KCYODD .NE. 2) A(N,ICOLIM1)= A(N,ICOLIM1) + C(N,ICOLM1)       ASSMBG   355
355             IF (KCYODD .NE. 1) A(N,ICOLI)= A(N,ICOLI) + C(N,ICOL)             ASSMBG   356
              750 CONTINUE                                                        ASSMBG   357
              C     REWRITE BLOCK IN PLACE IF WRITTEN BEFORE)                     ASSMBG   358
                CALL WRITO(LUK,A,NSIZE,NTKI)                                      ASSMBG   359
              C     PREPARE FOR NEXT BLOCK                                        ASSMBG   360
360           755 NR= NR - 1                                                      ASSMBG   361
                IF (NR .EQ. 0) GO TO 765                                          ASSMBG   362
              760 CONTINUE                                                        ASSMBG   363
              C     LAST, ROW OF BLOCKS, STARTING PAST THE DIAGONAL BLOCK         ASSMBG   364
              765 IF (NC .EQ. NN) GO TO 865                                       ASSMBG   365
365             NR= NC                                                            ASSMBG   366
                JJ= JDEL + 1                                                      ASSMBG   367
                DO 860 J=2,MM                                                     ASSMBG   368
              C     PICK UP DEPENDENT BLOCK                                       ASSMBG   369
                NTK= NRCD(NR,J)                                                   ASSMBG   370
370             NTKI= MOD(NTK,60)                                                 ASSMBG   371
                IF (NTKI .EQ. 0) NTKI= 60                                         ASSMBG   372
                NTK2= (NTK - 1) / 60 + 1                                          ASSMBG   373
                CALL UNPCK60  (KRECRD(NTK2), L, NTKI)                             ASSMBG   374
                NC= NC + 1                                                        ASSMBG   375
375             IF ( J - 1 - JDEL ) 770,775,780                                   ASSMBG   376
              770 JJ= JJ - 1                                                      ASSMBG   377
                NRR= NC                                                           ASSMBG   378
                GO TO 785                                                         ASSMBG   379
              775 JJ= 1                                                           ASSMBG   380
380             NRR= NRI                                                          ASSMBG   381
                GO TO 785                                                         ASSMBG   382
              780 JJ= JJ + 1                                                      ASSMBG   383
                NRR= NRI                                                          ASSMBG   384
              785 CONTINUE                                                        ASSMBG   385
385             IF (L .EQ. 0) GO TO 855                                           ASSMBG   386
                CALL READMS (LUK, C, NSIZE, NTK )                                 ASSMBG   387
              C     PICK UP INDEPENDENT BLOCK                                     ASSMBG   388
                NTKI= NRCD (NRR,JJ)                                               ASSMBG   389
                NTKI= MOD (NTKI,60)                                               ASSMBG   390
390             IF (NTKI1.EQ. 0) NTKI1= 60                                        ASSMBG   391
                NTKI2= (NTKI - 1) / 60 + 1                                        ASSMBG   392
                CALL UNPCK60 (KRECRD(NTKI2), L, NTKI1)                            ASSMBG   393
                IF (L .EQ. 0) GO TO 815                                           ASSMBG   394
                CALL READMS (LUK, A, NSIZE, NTKI )                                ASSMBG   395
395             IBEFOR= 1                                                         ASSMBG   396
                GO TO 820                                                         ASSMBG   397
              815 CALL MEMSET (A, A(NSIZE), 0. )                                  ASSMBG   398
                IBEFOR= 0                                                         ASSMBG   399
                CALL PACK60 ( KRECRD(NTKI2), 1, NTKI1 )                           ASSMBG   400
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      820 DO 830 N=1,NS                                                  ASSMBG  401
          IF (NRR .EQ. NRI) GO TO 825                                    ASSMBG  402
      C   ADD ROW (COLUMN TRANSPOSE) TO COLUMN                          ASSMBG  403
          IF (KCYODD.NE.2) A(N,ICOLIM1)= A(N,ICOLIM1) + C(ICOLM1,N)      ASSMBG  404
          IF (KCYODD.NE.1) A(N,ICOLI)= A(N,ICOLI) + C(ICOL,N)            ASSMBG  405
          GO TO 830                                                      ASSMBG  406
      C   ADD ROWS                                                       ASSMBG  407
      825 IF (KCYODD.NE.2) A(ICOLIM1,N)= A(ICOLIM1,N) + C(ICOLM1,N)      ASSMBG  408
          IF (KCYODD.NE.1) A(ICOLI,N)= A(ICOLI,N) + C(ICOL,N)            ASSMBG  409
      830 CONTINUE                                                       ASSMBG  410
      C   CHECK FOR INDEPENDENT DIAGONAL BLOCK                          ASSMBG  411
          IF (JJ .GT. 1) GO TO 850                                       ASSMBG  412
      C   ADD SAVED TERMS                                               ASSMBG  413
          IF (KCYODD .EQ. 1) GO TO 835                                   ASSMBG  414
          A(ICOLI,ICOLI)= A(ICOLI,ICOLI) + SAV22                         ASSMBG  415
          A(ICOLIM1,ICOLI)= A(ICOLIM1,ICOLI) + SAV21                     ASSMBG  416
      835 IF (KCYODD .EQ. 2) GO TO 840                                   ASSMBG  417
          A(ICOLIM1,ICOLIM1)= A(ICOLIM1,ICOLIM1) + SAV11                 ASSMBG  418
          A(ICOLI,ICOLIM1)= A(ICOLI,ICOLIM1) + SAV12                     ASSMBG  419
      C   SYMMETRY OF DIAGONAL BLOCK MUST BE RESTORED                   ASSMBG  420
      840 DO 845 N=1,NS                                                  ASSMBG  421
          IF (N .EQ. ICOLI .OR. N .EQ. ICOLIM1) GO TO 845                ASSMBG  422
          A(N,ICOLIM1)= A(ICOLIM1,N)                                     ASSMBG  423
          A(N,ICOLI)= A(ICOLI,N)                                         ASSMBG  424
      845 CONTINUE                                                       ASSMBG  425
      C   REWRITE BLOCK IN PLACE IF WRITTEN BEFORE                      ASSMBG  426
      850 CALL WRITO(LUK,A,NSIZE,NTKI)                                   ASSMBG  427
      C   PREPARE FOR NEXT BLOCK                                        ASSMBG  428
      855 IF (NC .EQ. NN) GO TO 865                                      ASSMBG  429
      860 CONTINUE                                                       ASSMBG  430
      C   ADD ROWS OF LOAD VECTORS                                       ASSMBG  431
      865 CALL READLUR(LUR,B,NS,NR)                                      ASSMBG  432
          CALL READLUR(LUR,C,NS,NRI)                                     ASSMBG  433
          IF (KCYODD .NE. 2) C(ICOLIM1)= C(ICOLIM1) + B(ICOLM1)          ASSMBG  434
          IF (KCYODD .NE. 1) C(ICOLI)= C(ICOLI) + B(ICOL)                ASSMBG  435
          CALL WRITLUR(LUR,C,NS,NRI,1)                                   ASSMBG  436
      C   MODIFICATIONS COMPLETE FOR THIS DDISP OR CYCLO PAIR           ASSMBG  437
      870 CONTINUE                                                       ASSMBG  438
          GO TO 710                                                      ASSMBG  439
      C   ALL MODS COMPLETED FOR DDISP, CYCLO                           ASSMBG  440
      890 CONTINUE                                                       ASSMBG  441
      C   NON-ZERO SPECIFIED DISPLACEMENTS                               ASSMBG  442
          NDEL1=NDEL+1                                                   ASSMBG  443
          DO 480 I=1,NODES                                               ASSMBG  444
          M=0                                                            ASSMBG  445
          U(1)=0.                                                        ASSMBG  446
          IF (FDZ(I).EQ.0.) GO TO 350                                    ASSMBG  447
          CALL UNPCK60 (KODEHC(I),KODEZ,1)                               ASSMBG  448
          IF (KODEZ.EQ.0) GO TO 350                                      ASSMBG  449
          U(1)=FDZ(I)                                                    ASSMBG  450
          M=1                                                            ASSMBG  451
      350 IF (FDR(I).EQ.0.) GO TO 360                                    ASSMBG  452
          CALL UNPCK60 (KODEHC(I),KODER,2)                               ASSMBG  453
          IF (KODER.EQ.0) GO TO 360                                      ASSMBG  454
          U(2)=FDR(I)                                                    ASSMBG  455
          M=2                                                            ASSMBG  456
      360 IF (M.EQ.0) GO TO 480                                          ASSMBG  457
```

```
      C     U ARRAY CONTAINS M VALUES OF SPECIFIED DEFLECTIONS -- DUMMY VALUES ASSMBG  458
      C           PRESENT (IF ANY)  ARE SET TO ZERO                            ASSMBG  459
      C     SET ROW BLOCK NO.                                                  ASSMBG  460
  460       NR=(I-1)/NDELI+1                                                   ASSMBG  461
      C     NC1= FIRST COLUMN OF UPPER BLOCKS TO BE ACCESSED                   ASSMBG  462
            NC1=(I-1)*NDOF-(NR-1)*NS+1                                         ASSMBG  463
            NC2=NC1+M-1                                                        ASSMBG  464
            NC=NR                                                              ASSMBG  465
  465       DO 420 J=1,MM                                                      ASSMBG  466
      C     BLOCK NO. IN STIFFNESS MATRIX                                      ASSMBG  467
            NTK=NRCD(NC,J)                                                     ASSMBG  468
            NTK1=MOD(NTK,60)                                                   ASSMBG  469
            IF (NTK1.EQ.0) NTK1=60                                             ASSMBG  470
  470       NTK2=(NTK-1)/60+1                                                  ASSMBG  471
      C     TEST FOR ZERO BLOCK                                                ASSMBG  472
            CALL UNPCK60 (KRECRD(NTK2),L,NTK1)                                 ASSMBG  473
            IF (L.EQ.0) GO TO 410                                              ASSMBG  474
            CALL READLUR(LUK,B,NS,NC)                                          ASSMBG  475
  475       CALL READMS (LUK,A,NSIZE,NTK)                                      ASSMBG  476
            DO 380 N=1,NS                                                      ASSMBG  477
            LL=1                                                               ASSMBG  478
            DO 370 K=NC1,NC2                                                   ASSMBG  479
            B(N)=B(N)-A(N,K)*U(LL)                                             ASSMBG  480
  480     370 LL=LL+1                                                          ASSMBG  481
          380 CONTINUE                                                         ASSMBG  482
      C     CHECK FOR DIAG. BLOCK                                              ASSMBG  483
            IF (J.NE.1) GO TO 400                                              ASSMBG  484
            LL=1                                                               ASSMBG  485
  485       DO 390 K=NC1,NC2                                                   ASSMBG  486
            IF (U(LL).EQ.0.) GO TO 390                                         ASSMBG  487
            B(K)=U(LL)                                                         ASSMBG  488
          390 LL=LL+1                                                          ASSMBG  489
      C     REWRITE VECTORS                                                    ASSMBG  490
  490     400   CALL WRITLUR(LUK,B,NS,NC,1)                                    ASSMBG  491
      C     PREPARE FOR NEXT UPPER BLOCK                                       ASSMBG  492
          410 NC=NC-1                                                          ASSMBG  493
            IF (NC.EQ.0) GO TO 430                                             ASSMBG  494
          420 CONTINUE                                                         ASSMBG  495
  495 C     NOW LOWER BLOCKS (TRANSPOSE OF UPPER BLOCKS )                      ASSMBG  496
          430 IF (NR.EQ.NN) GO TO 480                                          ASSMBG  497
            NC=NR+1                                                            ASSMBG  498
            DO 470 J=2,MM                                                      ASSMBG  499
      C     BLOCK NO.                                                          ASSMBG  500
  500       NTK=NRCD(NR,J)                                                     ASSMBG  501
            NTK1=MOD(NTK,60)                                                   ASSMBG  502
            IF (NTK1.EQ.0) NTK1=60                                             ASSMBG  503
            NTK2=(NTK-1)/60+1                                                  ASSMBG  504
      C     CHECK FOR ZERO BLOCK                                               ASSMBG  505
  505       CALL UNPCK60 (KRECRD(NTK2),L,NTK1)                                 ASSMBG  506
            IF (L.EQ.0) GO TO 460                                              ASSMBG  507
            CALL READLUR(LUK,B,NS,NC)                                          ASSMBG  508
            CALL READMS (LUK,A,NSIZE,NTK)                                      ASSMBG  509
            DO 450 N=1,NS                                                      ASSMBG  510
  510       LL=1                                                               ASSMBG  511
            DO 440 K=NC1,NC2                                                   ASSMBG  512
            B(N)=B(N)-A(K,N)*U(LL)                                             ASSMBG  513
          440 LL=LL+1                                                          ASSMBG  514
```

```
                450 CONTINUE                                                                    ASSMBG  515
                C     REWRITE                                                                   ASSMBG  516
515             C     CALL WRITLUR(LUR,B,NS,NC+1)                                               ASSMBG  517
                C     PREPARE FOR NEXT BLOCK                                                    ASSMBG  518
                460 NC=NC+1                                                                     ASSMBG  519
                    IF (NC.GT.NN) GO TO 480                                                     ASSMBG  520
520             470 CONTINUE                                                                    ASSMBG  521
                480 CONTINUE                                                                    ASSMBG  522
                C --- NOTE -- SPECIFIED DEFLECTIONS MUST BE RESET INTO SOLUTION VECTOR           ASSMBG  523
                C                 AFTER SOLUTION BY SYMSOL                                      ASSMBG  524
                C                                                                               ASSMBG  525
                                                                                                ASSMBG  526
525                 END
```



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```
      OVERLAY(ISOFR1,6,2)                                                SYMSOL     2
      PROGRAM SYMSOL                                                     SYMSOL     3
C                                                                        SYMSOL     4
C     NN  = NO. OF BLOCKS ON DIAGONAL (FCT. OF NO. OF EQUATIONS)         SYMSOL     5
C     MM  = NO. OF BLOCKS PER ROW (FCT. OF BAND)                         SYMSOL     6
C     NS  = ORDER OF MATRIX BLOCKS                                       SYMSOL     7
C     NCOUNT= NS * NS                                                    SYMSOL     8
C     LUK= UNIT WHERE STIFFNESS BLOCKS ARE STORED                        SYMSOL     9
C     LUR= UNIT WHERE LOAD VECTOR BLOCKS ARE STORED                      SYMSOL    10
C     LUT= UNIT FOR SCRATCH USAGE (NN BLOCKS)                            SYMSOL    11
C     KRECRD CONTAINS FLAGS FOR ZERO BLOCKS                              SYMSOL    12
C                                                                        SYMSOL    13
C     VARIABLES MUST BE DIMENSIONED --                                   SYMSOL    14
C        AK1(NSIZ), AK2(NSIZ), AK3(NSIZ), RB1(NS), RB2(NS), RB3(NS)      SYMSOL    15
C        KRECRD(MAX NO OF BLOCKS)                                        SYMSOL    16
C                                                                        SYMSOL    17
      COMMON/SYMSL1/AK1(144)                                             SYMSOL    18
      COMMON/SYMSL2/AK2(144)                                             SYMSOL    19
      COMMON/SYMSL3/AK3(144)                                             SYMSOL    20
      COMMON/SYMSL4/RB1(12)                                              SYMSOL    21
      COMMON/SYMSL5/RB2(12)                                              SYMSOL    22
      COMMON/SYMSL6/RB3(12)                                              SYMSOL    23
      COMMON / NSX / NS                                                  SYMSOL    24
      COMMON/SYMSOL/NN,MM,NNPE,NDOF,NVECT,NODES,NELEM,NW,LUT,LUK,LUE,    SYMSOL    25
     +LUR,INDEX3(41),INDEX7(146),INDEX17(821),INDEX19(41),KRECRD(820),   SYMSOL    26
     +NEQ                                                                SYMSOL    27
C                                                                        SYMSOL    28
      NRCD(I,J)= ( (I+J) * (I+J-1) ) / 2 -J +1                           SYMSOL    29
C                                                                        SYMSOL    30
      NNMMP1= NN - MM + 1                                                SYMSOL    31
      NCOUNT= NS * NS                                                    SYMSOL    32
      LENB= NS * NVECT                                                   SYMSOL    33
      KMM= MM                                                            SYMSOL    34
C     BEGIN FORWARD REDUCTION                                            SYMSOL    35
      N= 0                                                               SYMSOL    36
  100 N= N + 1                                                           SYMSOL    37
C                                                                        SYMSOL    38
C     REDUCE MATRIX ROW N                                                SYMSOL    39
C                                                                        SYMSOL    40
C     PICK UP DIAGONAL MATRIX BLOCK AND INVERT                           SYMSOL    41
      NTK= NRCD(N,1)                                                     SYMSOL    42
   10 FORMAT(1H ,*NTK=*,I4)                                              SYMSOL    43
      CALL READMS (LUK, AK2, NCOUNT, NTK)                                SYMSOL    44
      CALL INVERTS                                                       SYMSOL    45
C     PICK UP VECTOR BLOCK CORRES. TO ROW N                              SYMSOL    46
      CALL READLUR(LUR,RB1,LENB,N)                                       SYMSOL    47
      CALL MULT (RB1, RB2, NVECT)                                        SYMSOL    48
      CALL WRITLUR(LUR,RB2,LENB,N)                                       SYMSOL    49
C                                                                        SYMSOL    50
C     CHECK FOR LAST ROW OF MATRICES                                     SYMSOL    51
C                                                                        SYMSOL    52
      IF (N .EQ. NN) GO TO 300                                           SYMSOL    53
C                                                                        SYMSOL    54
C     REDUCE BLOCKS IN ROW N                                             SYMSOL    55
C                                                                        SYMSOL    56
      IF (N .GT. NNMMP1) KMM= KMM - 1                                    SYMSOL    57
      DO 200 K= 2, KMM                                                   SYMSOL    58
```



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      C     PICK UP OFF-DIAGONAL BLOCK                                        SYMSOL     59
            NIK= NRCD (N,K)                                                   SYMSOL     60
   60       C     CHECK IF ZERO BLOCK                                         SYMSOL     61
            NIK1= MOD( NIK, 60 )                                              SYMSOL     62
            IF ( NIK1 .EQ. 0) NIK1= 60                                        SYMSOL     63
            NIK2=  ( NIK - 1 ) / 60 + 1                                       SYMSOL     64
            CALL UNPCK60 ( KRECRD(NIK2), I  , NIK1 )                          SYMSOL     65
            IF (I   .EQ. 0 ) GO TO 200                                        SYMSOL     66
   65       CALL READMS (LUK, AK1,NCOUNT, NIK)                                SYMSOL     67
            CALL MULT     ( AK1, AK3, NS )                                    SYMSOL     68
            CALL WRITO(LUK,AK3,NCOUNT,NIK)                                    SYMSOL     69
      C     TRANSPOSE BLOCK AND SAVE ON SCRATCH FILE FOR REDUCING REST OF ROWS SYMSOL     70
            IL= 0                                                             SYMSOL     71
   70       DO 160 I=1,NS                                                     SYMSOL     72
            IR= 1                                                             SYMSOL     73
            DO 150 J=1,NS                                                     SYMSOL     74
            IL= IL + 1                                                        SYMSOL     75
            AK3(IL)= AK1(IR)                                                  SYMSOL     76
   75     150 IR= IR + NS                                                     SYMSOL     77
          160  CONTINUE                                                       SYMSOL     78
            CALL WRITO(LUT,AK3,NCOUNT,K)                                      SYMSOL     79
          200 CONTINUE                                                        SYMSOL     80
      C                                                                       SYMSOL     81
   80     C     REDUCE REST OF ROWS                                           SYMSOL     82
      C                                                                       SYMSOL     83
            DO 250 L=2,KMM                                                    SYMSOL     84
            I= N + L - 1                                                      SYMSOL     85
            IF (I .GT. NN) GO TO 100                                          SYMSOL     86
   85       C     PICK UP REDUCING BLOCK FROM SCRATCH                         SYMSOL     87
            C     CHECK IF ZERO BLOCK                                         SYMSOL     88
            NIK= NRCD(N,L)                                                    SYMSOL     89
            NIK1= MOD( NIK, 60 )                                              SYMSOL     90
   90       IF ( NIK1 .EQ. 0) NIK1= 60                                        SYMSOL     91
            NIK2=  ( NIK - 1 ) / 60 + 1                                       SYMSOL     92
            CALL UNPCK60 ( KRECRD(NIK2), J  , NIK1 )                          SYMSOL     93
            IF (J   .EQ. 0 ) GO TO 260                                        SYMSOL     94
            CALL READMS (LUT, AK2, NCOUNT, L )                                SYMSOL     95
   95       J= 0                                                              SYMSOL     96
            DO 250 K=L,KMM                                                    SYMSOL     97
            J= J + 1                                                          SYMSOL     98
            NIK= NRCD (N,K)                                                   SYMSOL     99
      C     CHECK IF ZERO BLOCK                                             SYMSOL    100
  100       NIK1= MOD( NIK, 60 )                                            SYMSOL    101
            IF ( NIK1 .EQ. 0) NIK1= 60                                        SYMSOL    102
            NIK2=  ( NIK - 1 ) / 60 + 1                                       SYMSOL    103
            CALL UNPCK60 ( KRECRD(NIK2), II , NIK1 )                          SYMSOL    104
            IF (II  .EQ. 0 ) GO TO 250                                        SYMSOL    105
  105       CALL READMS (LUK, AK1, NCOUNT, NIK )                              SYMSOL    106
            CALL MULT     ( AK1, AK3, NS )                                    SYMSOL    107
            NIK= NRCD(I,J)                                                    SYMSOL    108
      C     CHECK IF ZERO BLOCK                                             SYMSOL    109
            NIK1= MOD( NIK, 60 )                                              SYMSOL    110
  110       IF ( NIK1 .EQ. 0) NIK1= 60                                      SYMSOL    111
            NIK2=  ( NIK - 1 ) / 60 + 1                                       SYMSOL    112
            CALL UNPCK60 ( KRECRD(NIK2), II , NIK1 )                          SYMSOL    113
            IF (II  .EQ. 0 ) GO TO 220                                        SYMSOL    114
            CALL READMS (LUK, AK1, NCOUNT, NIK )                              SYMSOL    115
```

```
115                DO 210 I1=1,NCOUNT                                    SYMSOL  116
                 210 AK1(I1)= AK1(I1) - AK3(I1)                          SYMSOL  117
                     GO TO 240                                           SYMSOL  118
                 220 DO 230 I1= 1,NCOUNT                                 SYMSOL  119
                 230 AK1(I1)= - AK3(I1)                                  SYMSOL  120
120              C   SET FLAG FOR NON-ZERO BLOCK                         SYMSOL  121
                     CALL PACK60 ( KRECRD(NTK2), 1 , NTK1 )              SYMSOL  122
                 240 CALL WRITUT(LUK,AK1,NCOUNT,NTK)                     SYMSOL  123
                 250 CONTINUE                                            SYMSOL  124
                     CALL MULT (RR2, RR3, NVECT)                         SYMSOL  125
125              C   REDUCE CORRES. VECTOR BLOCK ROW                     SYMSOL  126
                     CALL READLUR(LUR,RB1,LENB,I)                        SYMSOL  127
                     DO 255 I1= 1, LENB                                  SYMSOL  128
                 255 RB1(I1)= RB1(I1) - RB3(I1)                          SYMSOL  129
                     CALL WRITLUR(LUR,RB1,LENB,I,1)                      SYMSOL  130
130                260 CONTINUE                                          SYMSOL  131
                     GO TO 100                                           SYMSOL  132
                 C                                                       SYMSOL  133
                 C   BACK SUBSTITUTION                                   SYMSOL  134
                 C                                                       SYMSOL  135
135                300 N= N - 1                                          SYMSOL  136
                 C                                                       SYMSOL  137
                 C   CHECK FOR FIRST ROW OF BLOCKS                       SYMSOL  138
                 C                                                       SYMSOL  139
                     IF (N .EQ. 0) GO TO 500                             SYMSOL  140
140              C                                                       SYMSOL  141
                 C   CALCULATE ANSWERS FOR THIS ROW                      SYMSOL  142
                 C                                                       SYMSOL  143
                     CALL READLUR(LUR,RR3,LENB,N)                        SYMSOL  144
                     DO 400 K=2,KMM                                      SYMSOL  145
145                  L= N + K - 1                                        SYMSOL  146
                     IF (L .GT. NN) GO TO 450                            SYMSOL  147
                     NTK= NRCD(N,K)                                      SYMSOL  148
                 C   CHECK IF ZERO BLOCK                                 SYMSOL  149
                     NTK1= MOD( NTK, 60 )                                SYMSOL  150
150                  IF ( NTK1 .EQ. 0) NTK1= 60                          SYMSOL  151
                     NTK2=  ( NTK - 1 ) / 60 + 1                         SYMSOL  152
                     CALL UNPCK60 ( KRECRD(NTK2), K1 , NTK1 )            SYMSOL  153
                     IF (K1  .EQ. 0 ) GO TO 400                          SYMSOL  154
                     CALL READMS (LUK, AK2, NCOUNT, NTK )                SYMSOL  155
155                  CALL READLUR(LUR,RB1,LENB,L)                        SYMSOL  156
                     CALL MULT (RB1, RB2, NVECT)                         SYMSOL  157
                     DO 310 K1= 1,LENB                                   SYMSOL  158
                 310 RB3(K1)= RB3(K1) - RB2(K1)                          SYMSOL  159
                 400 CONTINUE                                            SYMSOL  160
160              450 CALL WRITLUR(LUR,RB3,LENB,N,1)                      SYMSOL  161
                     KMM= KMM + 1                                        SYMSOL  162
                     IF (KMM .GT. MM) KMM= MM                            SYMSOL  163
                     GO TO 300                                           SYMSOL  164
                 500 CONTINUE                                            SYMSOL  165
165                  END                                                 SYMSOL  166
```

250

0 0 2 5 0 6

CARD NR. SEVERITY DETAILS DIAGNOSIS OF PROBLEM

129 I ) ARGUMENT COUNT INCONSISTENT WITH PRIOR USAGE.
160 I ) ARGUMENT COUNT INCONSISTENT WITH PRIOR USAGE.



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```
      SUBROUTINE MULT   (B,C,NC)                                        SYMSOL   167
      DIMENSION A(1), B(1), C(1)                                        SYMSOL   168
      COMMON / SYMSL2 / A                                               SYMSOL   169
      COMMON / SYMSOL / NN, MM                                          SYMSOL   170
      COMMON / NSX / NR                                                 SYMSOL   171
C                                                                       SYMSOL   172
C     MULTIPLY A(NR,NR) * B(NR,NC) AND STORE IN C(NR,NC)                SYMSOL   173
C                                                                       SYMSOL   174
      DO 300 I=1,NR                                                     SYMSOL   175
      IC= 1                                                             SYMSOL   176
      JJ= 0                                                             SYMSOL   177
      DO 200 J=1,NC                                                     SYMSOL   178
      SUM= 0.                                                           SYMSOL   179
      IA= 1                                                             SYMSOL   180
      IB= JJ                                                            SYMSOL   181
      DO 100 K=1,NR                                                     SYMSOL   182
      IB= IB + 1                                                        SYMSOL   183
      SUM= SUM + A(IA) * B(IB)                                          SYMSOL   184
  100 IA= IA + NR                                                       SYMSOL   185
      C(IC)= SUM                                                        SYMSOL   186
      IC= IC + NR                                                       SYMSOL   187
      JJ= JJ + NR                                                       SYMSOL   188
  200 CONTINUE                                                          SYMSOL   189
  300 CONTINUE                                                          SYMSOL   190
      RETURN                                                            SYMSOL   191
      END                                                               SYMSOL   192
```



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```
      SUBROUTINE INVERTS                                                SYMSOL  193
C                                                                       SYMSOL  194
C     INVERT SYMMETRIC MATRIX S(NM,NM)                                  SYMSOL  195
C     ONLY THE UPPER HALF OF S MUST BE SUPPLIED                         SYMSOL  196
C     THE FULL INVERSE IS RETURNED                                      SYMSOL  197
C                                                                       SYMSOL  198
      COMMON / SYMSL2 / S(1)                                            SYMSOL  199
      COMMON/SYMSOL/NN,MM                                               SYMSOL  200
      COMMON / NSx / M                                                  SYMSOL  201
C     M IS THE MATRIX SIZE                                              SYMSOL  202
   10 DO 110 J=1,M                                                      SYMSOL  203
      IJ=J-1                                                            SYMSOL  204
      IJM= IJ * M                                                       SYMSOL  205
C     SWEEP OUT ALL ROWS EXCEPT PIVOTAL ROW J                           SYMSOL  206
      XPIV=S(IJM + J )                                                  SYMSOL  207
      IF (XPIV .EQ. 0. ) GO TO 500                                      SYMSOL  208
      DO 90 I=1,M                                                       SYMSOL  209
      IF (J-I) 40,90,20                                                 SYMSOL  210
   20 JJ= IJM + I                                                       SYMSOL  211
      IF (S(JJ) .EQ. 0.) GO TO 90                                       SYMSOL  212
      JC=J                                                              SYMSOL  213
      AX=S( JJ)/XPIV                                                    SYMSOL  214
      II= 0                                                             SYMSOL  215
      DO 30 K=1,I                                                       SYMSOL  216
      S(II+I)= S(II+I) - AX * S(II+J)                                   SYMSOL  217
   30 II= II + M                                                        SYMSOL  218
      GO TO 70                                                          SYMSOL  219
   40 JC=I                                                              SYMSOL  220
      AX=S( (I-1)*M + J ) / XPIV                                        SYMSOL  221
      IF (AX .EQ. 0. ) GO TO 85                                         SYMSOL  222
      IF (IJ) 70,70,50                                                  SYMSOL  223
   50 II= 0                                                             SYMSOL  224
      DO 60 K=1,IJ                                                      SYMSOL  225
      S(II+I)= S(II+I) - AX * S(II+J)                                   SYMSOL  226
   60 II= II + M                                                        SYMSOL  227
   70 DO 80 K=JC,M                                                      SYMSOL  228
      II= (K - 1 ) * M                                                  SYMSOL  229
   80 S(II+I)= S(II+I) - AX * S(II+J)                                   SYMSOL  230
   85 S(IJM+I)= -AX                                                     SYMSOL  231
   90 CONTINUE                                                          SYMSOL  232
C                                                                       SYMSOL  233
C     SWEEP OUT PIVOTAL ROW J                                           SYMSOL  234
C                                                                       SYMSOL  235
      II= 0                                                             SYMSOL  236
      DO 100 K=1,M                                                      SYMSOL  237
      S(II+J)= S(II+J) / XPIV                                           SYMSOL  238
  100 II= II + M                                                        SYMSOL  239
      S(IJM + J )= S(IJM + J ) / XPIV                                   SYMSOL  240
  110 CONTINUE                                                          SYMSOL  241
      II= 0                                                             SYMSOL  242
      DO 130 I=1,M                                                      SYMSOL  243
      DO 120 J=1,M                                                      SYMSOL  244
  120 S( (J-1)*M + I ) = S(II+J)                                        SYMSOL  245
  130 II= II + M                                                        SYMSOL  246
      RETURN                                                            SYMSOL  247
C                                                                       SYMSOL  248
  500 IJ= IJ + I                                                        SYMSOL  249
```



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```
                      PRINT 1000, IJ                                    SYMSOL   250
                      STOP                                              SYMSOL   251
60                1000 FORMAT (23H0INVERT FAILURE AT ROW     IS)         SYMSOL   252
                      END                                               SYMSOL   253
```



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```
      OVERLAY(ISOPB1,6,3)                                                RECOVR     2
      PROGRAM RECOVR                                                     RECOVR     3
C                                                                        RECOVR     4
C     PRINT STRESSES AND DEFLECTIONS                                     RECOVR     5
C                                                                        RECOVR     6
      COMMON/LOD/F(480),JDISP(30),S(6,6),RK(30,30),UR(160),U(480)        RECOVR     7
      COMMON/PDEL/R(160),RF(162)                                         RECOVR     8
      COMMON /IZO/ IN,IOUT                                               RECOVR     9
      COMMON/PDDISP/NDDISP,I1DDSP(160),I2DDSP(160),DDISPY(160),DDISPX(16 RECOVR    10
     +0)                                                                 RECOVR    11
      COMMON/NSX/NS,LUZ                                                  RECOVR    12
       COMMON/BCP/KODEBC(160),FDZ(160),FDR(160)                          RECOVR    13
      COMMON /CURRMZ/ TITLE(8)                                           RECOVR    14
      COMMON/SYMSOL/NN,MM,NNPE,NDOF,NVECT,NODES,NELEM,Nw,LUT,LUK,LUE,    RECOVR    15
     +LUR,INDEX3(41),INDEX7(146),INDEX17(821),INDEX19(41),KRECRD(820),   RECOVR    16
     +NEG                                                                RECOVR    17
      COMMON/SET/NODSET(160)                                             RECOVR    18
      DIMENSION SPACE(480)                                               RECOVR    19
      COMMON /FOILLY/ IFOIL,NODFL                                        RECOVR    20
      COMMON/EC/EC                                                       RECOVR    21
      COMMON/PLOTQ/IPLOT(2),IPRINT,MPRINT                                RECOVR    22
      DIMENSION SPAC3(3,160)                                             RECOVR    23
      DIMENSION FORCES(480)                                              RECOVR    24
      EQUIVALENCE(SPACE,SPAC3)                                           RECOVR    25
C     RECOVER DEFLECTIONS                                                RECOVR    26
      L= 1                                                               RECOVR    27
      DO 100 I=1,NN                                                      RECOVR    28
      CALL READLUR(LUR,SPACE(L),NS,1)                                    RECOVR    29
  100 L= L + NS                                                          RECOVR    30
      DO 10 I=1,IFOIL                                                    RECOVR    31
      NODNM=(I-1)*NODFL+1                                                RECOVR    32
   10 SPAC3(2,NODNM)=0.                                                  RECOVR    33
      DO 160 J=1,NODES                                                   RECOVR    34
      CALL UNPCK60(KODEBC(J),1,2)                                        RECOVR    35
      IF(I.EQ.0)GO TO 160                                                RECOVR    36
      SPAC3(2,J)=FDR(J)                                                  RECOVR    37
  160 CONTINUE                                                           RECOVR    38
      DO 101 IJ=1,NDDISP                                                 RECOVR    39
      N=IABS(I1DDSP(IJ))                                                 RECOVR    40
      M=IABS(I2DDSP(IJ))                                                 RECOVR    41
      SPAC3(2,N)=SPAC3(2,M)+DDISPY(IJ)                                   RECOVR    42
  101 CONTINUE                                                           RECOVR    43
      J=1                                                                RECOVR    44
      DO 172 L=1,IFOIL                                                   RECOVR    45
      I1=(L-1)*NODFL+1                                                   RECOVR    46
      I2=L*NODFL                                                         RECOVR    47
      I3=(L-1)*NDOF*NODFL+1                                              RECOVR    48
C      LOAD DEFLECTIONS INTO U ARRAY                                     RECOVR    49
      DO 171 I=I1,I2                                                     RECOVR    50
      RF(I)=R(I)-SPAC3(2,I)                                              RECOVR    51
      DO 170 K=1,NDOF                                                    RECOVR    52
      U(J)=SPAC3(K,I)                                                    RECOVR    53
      J=J+1                                                              RECOVR    54
  170 CONTINUE                                                           RECOVR    55
      UR(I)=SPAC3(2,I)                                                   RECOVR    56
  171 CONTINUE                                                           RECOVR    57
C      SOLVE FOR PRELOADS                                                RECOVR    58
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```
                NEQ=NODFL*NDOF                                                  RECOVR     59
                CALL VMULFF(RK,U(I3),NFO,NEQ,1,30,480,FORCES(I3),480,IER)       RECOVR     60
   60       172 CONTINUE                                                        RECOVR     61
            C    LOAD FORCES INTO F ARRAY                                       RECOVR     62
                DO 175 I=1,480                                                  RECOVR     63
                F(I)=FORCES(I)                                                  RECOVR     64
            175 CONTINUE                                                        RECOVR     65
   65           N1=J                                                           RECOVR     66
                IMS=0                                                           RECOVR     67
                 IF(MPRINT.EQ.1.AND.IPRINT.GE.0)IMS=1                           RECOVR     68
                IF(MPRINT.EQ.0.AND.IPRINT.LT.0)IMS=2                            RECOVR     69
                IF(IPRINT.EQ.-1)IPRINT=0                                        RECOVR     70
   70           IF(IMS.EQ.0)GO TO 300                                          RECOVR     71
                WRITE(IOUT,80)                                                  RECOVR     72
                WRITE(IOUT,81) TITLE                                            RECOVR     73
                WRITE(IOUT,82)                                                  RECOVR     74
                IF(IMS.EQ.2)WRITE(61,220)EC                                     RECOVR     75
   75         220 FORMAT(1H ,*ECCENTRICITY = *,F7.4)                           RECOVR     76
                DO 110 I=1,IFOIL                                                RECOVR     77
                IF(IPRINT.EQ.0)WRITE(IOUT,201)I                                 RECOVR     78
                IF(IPRINT.NE.0)WRITE(IOUT,200)I                                 RECOVR     79
                J1=(I-1)*NODFL+1                                                RECOVR     80
   80           J2=I*NODFL                                                     RECOVR     81
                DO 105 J=J1,J2                                                  RECOVR     82
                NUM=J                                                           RECOVR     83
                NFOR=J*NDOF-1                                                   RECOVR     84
                BC=1H                                                           RECOVR     85
   85           CALL UNPCK60(KODEBC(NUM),L,2)                                  RECOVR     86
                IF(L.EQ.1.AND.NODSET(NUM).EQ.0)BC=1HB                           RECOVR     87
                IF(L.EQ.1.AND.NODSET(NUM).NE.0)BC=1HS                           RECOVR     88
                DO 120 ITY=1,NDDISP                                             RECOVR     89
                I1=IDDSP(ITY)                                                   RECOVR     90
   90           I2=IABS(IDDSP(ITY))                                            RECOVR     91
                IF(I1.EQ.NUM)GO TO 130                                          RECOVR     92
                IF(I2.EQ.NUM)GO TO 140                                          RECOVR     93
            120 CONTINUE                                                        RECOVR     94
                TYPE=1H                                                         RECOVR     95
   95           ITY=0                                                          RECOVR     96
                GO TO 150                                                       RECOVR     97
            130 TYPE=1HD                                                        RECOVR     98
                BC=1H                                                           RECOVR     99
                GO TO 150                                                       RECOVR    100
  100       140 TYPE=1HI                                                        RECOVR    101
            150 CONTINUE                                                        RECOVR    102
                IF(IPRINT.EQ.0)WRITE(IOUT,211)J,R(J),SPAC3(2,J),RF(J),FORCES(NFOR) RECOVR    103
               *,TYPE,ITY,BC                                                    RECOVR    104
                IF(IPRINT.EQ.0)GO TO 105                                        RECOVR    105
  105           WRITE(IOUT,210)J,(SPAC3(K,NUM),K=1,NDOF),FORCES(NFOR),TYPE,ITY,BC RECOVR    106
              105 CONTINUE                                                      RECOVR    107
              110 CONTINUE                                                      RECOVR    108
            C                                                                   RECOVR    109
                IF(IPRINT.EQ.0)GO TO 300                                        RECOVR    110
  110           DO 853 L=1,IFOIL                                                RECOVR    111
                I1=(L-1)*NODFL+1                                                RECOVR    112
                I2=L*NODFL                                                      RECOVR    113
                WRITE(61,850)                                                   RECOVR    114
            850 FORMAT(//,1H0,*NODE*,12X,*RINITIAL*,19X,*U*,14X,*RFINAL*,/,     RECOVR    115
```

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115              +1X,80(1H*),/)                                                    RECOVR   116
                  DO 822 I=11,12                                                   RECOVR   117
                  WRITE(61,851)I,R(I),SPAC3(2,I),RF(I)                             RECOVR   118
            822   CONTINUE                                                         RECOVR   119
            851   FORMAT(1H ,I4,3F20.4)                                            RECOVR   120
120               WRITE(61,852)                                                    RECOVR   121
            853   CONTINUE                                                         RECOVR   122
            852   FORMAT(1H0,80(1H*))                                              RECOVR   123
             80   FORMAT(1H1)                                                      RECOVR   124
             81   FORMAT(/,1X,8A10)                                                RECOVR   125
125          82   FORMAT(/,2X,*SYSTEM DESCRIPTION*//)                              RECOVR   126
            200   FORMAT(/2X,*FOIL =*,I3,10X,*D.O.F. 1*,11X,*D.O.F. 2*,11X,        RECOVR   127
                 + *D.O.F. 3*,11X,*RADIAL FORCE*,11X,*OVERLAP PAIRS*,3X,*B.C.*)   RECOVR   128
            210   FORMAT(4X,*NODE =*I3,4(4X,E15.7),10X,A1,I3,14X,A1)               RECOVR   129
            211   FORMAT(4X,*NODE =*I3,4(F11.4,8X),10X,A1,I3,14X,A1)               RECOVR   130
130         201   FORMAT(/2X,*FOIL =*,I3,10X,*RINITIAL*,9X,*RADIAL DEFL*,10X,*RFINAL RECOVR   131
                 +*,13X,*RADIAL FORCE*,11X,*OVERLAP PAIRS*,3X,*B.C.*)             RECOVR   132
            300   CONTINUE                                                         RECOVR   133
                  END                                                              RECOVR   134
```



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      OVERLAY(ISOFB1,5,0)                                                MAIN2    2
      PROGRAM MAIN2                                                      MAIN2    3
      COMMON/SYMSOL/NN,MM,NNPE,NDOF,NVECT,NODES                          MAIN2    4
      COMMON/CURRMZ/DUM(38),FNOA(160)                                    MAIN2    5
      COMMON/FOILLY/IFOIL,NODFL,N,M,N1,N2,M1,M2                          MAIN2    6
      COMMON/ITER/ITERATE,LIM,ERROR                                      MAIN2    7
      COMMON S(1),RECR,PV,KNOT,INPP,INCF,FILMP,DZD,BETA(42),Q(5,42),     MAIN2    8
     +IP(5,42),U(5,42),ALPHD(5),E(5),EDOT(5),ALPHA(5),ZD(5),RHO,AO,      MAIN2    9
     +H(5,42),EMRA,INC,PBRM,PBR1,NSB,IEXT,VARPS,VARA,VARDY,AD,CV,SHR,PS, MAIN2   10
     +RGAS,TGAS,ERRDP,ID1,ID2,ID3,IRP0,IRM,IRB,IRO,ALPH1,RELAXH,HMIN,    MAIN2   11
     +CAVE,RFHAVE,LP,C(5,42),CODE(5,42),DIFU(5,42),PAPZ(5,42),RE(5,42),  MAIN2   12
     +SRR(5,42),UBAR(5,42),WBAR(5,42),XK(5,42),RELAX,DELXB(5,42),        MAIN2   13
     +ZK(5,42),PAPI(5,42),PP(5,42),DELXA(42),DELZA(42),U9,DELZB(5),QLX   MAIN2   14
     +(42),QMX(42),QRX(42),QLZ(5),QMZ(5),QRZ(5),OP(5,42),OOP(5,42),      MAIN2   15
     +X(5,42),P(5,42)                                                    MAIN2   16
      COMMON/L/AXLEN                                                     MAIN2   17
      COMMON/RT/RK,R,RS,T                                                MAIN2   18
      COMMON/EC/E1,PSI                                                   MAIN2   19
      COMMON/PDEL/RX(160),RF(162),RSP(160)                               MAIN2   20
      COMMON/KEY/NODEE(82),NODEH(160)                                    MAIN2   21
      COMMON/FOR/HFORCE(160)                                             MAIN2   22
      COMMON/HOLER/H2(5,82),X2(5,82),C2(5,82),BETA2(82),NE,ME,NE1,NE2,   MAIN2   23
     +ME1,ME2                                                            MAIN2   24
C                                                                        MAIN2   25
      EMAX=0.                                                            MAIN2   26
      CALL ETIME                                                         MAIN2   27
      IF(ITERATE.EQ.0)CALL OVERLAY(6HISOFB1,5,1)                         MAIN2   28
      IF(ITERATE.EQ.0)GO TO 100                                          MAIN2   29
C      LOAD COMMON SAVE                                                  MAIN2   30
      READ(10)(S(I),I=1,4748)                                            MAIN2   31
      REWIND 10                                                          MAIN2   32
C      CHECK FOR CONVERGENCE                                             MAIN2   33
      EMAX=0.                                                            MAIN2   34
      IF(ITERATE.EQ.0)GO TO 100                                          MAIN2   35
      ISAVE=2                                                            MAIN2   36
      NOGOOD=0                                                           MAIN2   37
      DO 10 I=2,NE1                                                      MAIN2   38
      EPSILON=ABS(H2(1,I)+RSP(NODEE(I))-RF(NODEE(I)))/H2(1,I)            MAIN2   39
      IF(EPSILON.GE.EMAX)ISAVE=NODEE(I)                                  MAIN2   40
      EMAX=AMAX1(EMAX,EPSILON)                                           MAIN2   41
      HFORCE(I)=EPSILON                                                  MAIN2   42
      IF(EMAX.LE.ERROR)GO TO 10                                          MAIN2   43
      NOGOOD=1                                                           MAIN2   44
   10 CONTINUE                                                           MAIN2   45
      IF(NOGOOD.EQ.1)GO TO 100                                           MAIN2   46
C       THIS IS A CONVERGED CASE                                         MAIN2   47
      WRITE(6,900)ITERATE,EMAX,ISAVE                                     MAIN2   48
  900 FORMAT(1H0,10(1H*),* THIS IS A CONVERGED CASE *,10(1H*),/,         MAIN2   49
     +11X,*NUMBER OF ITERATIONS= *,I3,/,11X,*MAXIMUM ERROR = *,E12.5,    MAIN2   50
     +3X,*AT NODE *,I3)                                                  MAIN2   51
      ITERATE=LIM                                                        MAIN2   52
      GO TO 1000                                                         MAIN2   53
  100 CONTINUE                                                           MAIN2   54
C       NOT A CONVERGED CASE                                             MAIN2   55
      WRITE(6,901)ITERATE,EMAX                                           MAIN2   56
  901 FORMAT(1H0,*ITERATION NUMBER *,I3,/,1X,* MAX ERROR =*,E12.5)       MAIN2   57
      WRITE(6,903)(I,HFORCE(I-1),I=1,NE)                                 MAIN2   58
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  903 FORMAT(1H ,3(1X,*ERROR(*,I3,*)= *,E15.5,3X))                    MAIN2   59
      IF(ITERATE.EQ.0)GO TO 151                                       MAIN2   60
      IF(ITERATE.EQ.20)RELAXH=RELAXH/2.                               MAIN2   61
       IF(ITERATE.EQ.10)RELAXH=RELAXH/2.                              MAIN2   62
      IF(ITERATE.EQ.10.OR.ITERATE.EQ.20)WRITE(61,902)RELAXH           MAIN2   63
  902 FORMAT(1H0,10(*-*),* RELAXATION FACTOR CHANGED TO *,E12.5,      MAIN2   64
     +* BY PROGRAM TO AID IN CONVERGENCE*)                            MAIN2   65
C      DEFINE NEW H                                                   MAIN2   66
      DO 150 I=1,ME                                                   MAIN2   67
      DO 150 J=2,NE1                                                  MAIN2   68
      K=NODEE(J)                                                      MAIN2   69
      H2(I,J)=RELAXH*(RF(K)-RSP(K))+(1.-RELAXH)*H2(I,J)               MAIN2   70
  150 CONTINUE                                                        MAIN2   71
      DO 160 I=1,ME                                                   MAIN2   72
      H2(I,1)=H2(I,NE1)                                               MAIN2   73
      H2(I,NE2)=H2(I,2)                                               MAIN2   74
  160 CONTINUE                                                        MAIN2   75
  151 CONTINUE                                                        MAIN2   76
      DO 152 I=1,ME                                                   MAIN2   77
      DO 152 J=2,NE1                                                  MAIN2   78
      IF(ITERATE.NE.0)C2(I,J)=RSP(NODEE(J))-RS+H2(I,J)                MAIN2   79
  152 CONTINUE                                                        MAIN2   80
C  FIND INTERPOLATED VALUES FOR HYDRO                                 MAIN2   81
      CALL MEMSET(HFORCE(1),HFORCE(160),0.)                           MAIN2   82
      CALL MATPRT(5,H2,ME,NE1,X2)                                     MAIN2   83
      DO 175 L=1,IFOIL                                                MAIN2   84
      I1=(L-1)*NODFL/2+1                                              MAIN2   85
      I2=I1+NODFL/2                                                   MAIN2   86
      CALL LAGRANG(H2,X2,I1,I2,N,H,X,M,T)                             MAIN2   87
      CALL LAGRANG(C2,X2,I1,I2,N,C,X,M,T)                             MAIN2   88
      CALL OVERLAY(6HISOFB1,5,2,6HRECALL)                             MAIN2   89
      NODFL2=NODFL/2                                                  MAIN2   90
      DO 174 J=1,NODFL2                                               MAIN2   91
      NODE1=(L-1)*NODFL2+J                                            MAIN2   92
      NODE2=NODE1+1                                                   MAIN2   93
      XX1=X2(1,NODE1)                                                 MAIN2   94
      XX2=X2(1,NODE2)                                                 MAIN2   95
      CALL HLOAD(XX1,XX2,F1,F2,M,N,NODFL2)                            MAIN2   96
      K1=NODEE(NODE1)                                                 MAIN2   97
      K2=NODEE(NODE2)                                                 MAIN2   98
      HFORCE(K1)=HFORCE(K1)-F1                                        MAIN2   99
      HFORCE(K2)=HFORCE(K2)-F2                                        MAIN2  100
  174 CONTINUE                                                        MAIN2  101
  175 CONTINUE                                                        MAIN2  102
C      CALCULATE RESULTANT LOAD                                       MAIN2  103
      FX=0.                                                           MAIN2  104
      FY=0.                                                           MAIN2  105
      NODFL21=NODFL/2+1                                               MAIN2  106
      DO 176 I=1,IFOIL                                                MAIN2  107
      DO 176 J=NODFL21,NODFL                                          MAIN2  108
      K=(I-1)*NODFL+J                                                 MAIN2  109
      FX=FX+HFORCE(K)*COS(BETA2(NODEH(K)))                            MAIN2  110
      FY=FY+HFORCE(K)*SIN(BETA2(NODEH(K)))                            MAIN2  111
  176 CONTINUE                                                        MAIN2  112
      ANGLE=ATAN2(FY,FX)*180./3.14159265                              MAIN2  113
      WRITE(61,904)FX,FY,ANGLE                                        MAIN2  114
  904 FORMAT(1H0,125(1H*),/,1X,*X COMPONENT OF FORCE =*,F15.3,3X,      MAIN2  115
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                +* Y COMPONENT OF FORCE = *,F15.3,3X,* RESULTANT LOAD =*,F15.3,      MAIN2     116
               +/,1X,* ANGLE(DEGREES) =*,F15.3,/,1X,125(1H*))                       MAIN2     117
                HED=5HLOADS                                                         MAIN2     118
                WRITE(61,200)HED                                                    MAIN2     119
            200 FORMAT(1H1,A5)                                                      MAIN2     120
    120         CALL MATPRT(1,160,1,NODES,HFORCE)                                   MAIN2     121
                WRITE(10)(S(I),I=1,474R)                                            MAIN2     122
                REWIND 10                                                           MAIN2     123
           1000 CONTINUE                                                            MAIN2     124
                END                                                                 MAIN2     125
```

| CARD NR. | SEVERITY | DETAILS | DIAGNOSIS OF PROBLEM |
|---|---|---|---|
| 30 | I | | ARRAY REFERENCE OUTSIDE DIMENSION BOUNDS. |
| 88 | I | ) | ARGUMENT COUNT INCONSISTENT WITH PRIOR USAGE. |
| 121 | I | | ARRAY REFERENCE OUTSIDE DIMENSION BOUNDS. |

```
      SUBROUTINE LAGRANG(Y,X,I1,I2,NP,YSAVE,XSAVE,M,C)                  LAGRANG    2
      DIMENSION Y(5,82),X(5,82),YSAVE(5,42),A(82)                       LAGRANG    3
      DIMENSION YA(42),XA(42),XSAVE(5,42)                               LAGRANG    4
C*****************************************************************    LAGRANG    5
C     INTERPOLATION OF Y=Y(X) UTILIZING AN (N-1) ORDER LAGRANGIAN       LAGRANG    6
C     INTERPOLATION POLYNOMIAL                                          LAGRANG    7
C     Y(I)=Y(X(I)) ARE THE N INTERPOLATION POINTS                       LAGRANG    8
C     XMIN,DELX,XMAX SPECIFY THE REGION FOR THE INTERPOLATED RESULTS    LAGRANG    9
C*****************************************************************    LAGRANG   10
C                                                                       LAGRANG   11
      DO 5 I=1,M                                                        LAGRANG   12
    5 Y(I,I1)=Y(I,I1)+C                                                 LAGRANG   13
      N=I2-I1+1                                                         LAGRANG   14
      XMIN=X(1,I1)                                                      LAGRANG   15
      XMAX=X(1,I2)                                                      LAGRANG   16
      DELX=(XMAX-XMIN)/(FLOAT(NP-1))                                    LAGRANG   17
C                                                                       LAGRANG   18
C     CALCULATION OF LAGRANGIAN COEFFICIENTS                            LAGRANG   19
C                                                                       LAGRANG   20
      DO 110 J=I1,I2                                                    LAGRANG   21
      FACTOR=1.                                                         LAGRANG   22
      DO 100 K=I1,I2                                                    LAGRANG   23
      IF(K-J)80,100,80                                                  LAGRANG   24
   80 FACTOR=FACTOR*(X(1,J)-X(1,K))                                     LAGRANG   25
  100 CONTINUE                                                          LAGRANG   26
      A(J)=Y(1,J)/FACTOR                                                LAGRANG   27
  110 CONTINUE                                                          LAGRANG   28
C                                                                       LAGRANG   29
C     CALCULATION OF INERPOLATED DATA                                   LAGRANG   30
C                                                                       LAGRANG   31
      XARG=XMIN                                                         LAGRANG   32
      NP1=NP+1                                                          LAGRANG   33
      DO 1000 I=2,NP1                                                   LAGRANG   34
  900 YARG=0.                                                           LAGRANG   35
      DO 300 II=I1,I2                                                   LAGRANG   36
      PROD=1.                                                           LAGRANG   37
      DO 400 IND=I1,I2                                                  LAGRANG   38
      IF(IND-II)350,400,350                                             LAGRANG   39
  350 PROD=PROD*(XARG-X(1,IND))                                         LAGRANG   40
  400 CONTINUE                                                          LAGRANG   41
      YARG=YARG+PROD*A(II)                                              LAGRANG   42
  300 CONTINUE                                                          LAGRANG   43
      DO 500 J=1,M                                                      LAGRANG   44
      YA(I-1)=YARG*1000.                                                LAGRANG   45
      XA(I-1)=XARG                                                      LAGRANG   46
      XSAVE(J,I)=XARG                                                   LAGRANG   47
  500 YSAVE(J,I)=YARG                                                   LAGRANG   48
      XARG=XARG+DELX                                                    LAGRANG   49
 1000 CONTINUE                                                          LAGRANG   50
      DO 6 I=1,M                                                        LAGRANG   51
    6 Y(I,I1)=Y(I,I1)-C                                                 LAGRANG   52
      CALL XRANGE(XA,1,NP,XL,XS)                                        LAGRANG   53
      CALL YRANGE(YA,1,NP,YL,YS)                                        LAGRANG   54
      CALL PLT20(XA,YA,1,NP,49,XL,XS,YL,YS)                             LAGRANG   55
      RETURN                                                            LAGRANG   56
   30 FORMAT(10X,2F15.8)                                                LAGRANG   57
      END                                                               LAGRANG   58
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```
      SUBROUTINE HLOAD(X1,X2,F1,F2,NA,NN,NODFL2,                        HLOAD      2
     C      CALCULATES TWO END LOADS FROM DISTRIBUTED PRESSURES         HLOAD      3
            DIMENSION G(50),L(4),XX(20),PARRAY(210),XARRAY(210),UL(20)  HLOAD      4
            COMMON S(1),BECK,PV,KNOT,INPP,INCF,FILMP,DZD,BETA(42),Q(5,42),HLOAD    5
           +IP(5,42),U(5,42),ALPHD(5),E(5),EDOT(5),ALPHA(5),ZD(5),RHO,AO,HLOAD     6
           +H(5,42),ERRA,IRC,PHRM,PBR1,NSB,IEXT,VARPS,VARA,VARDY,AD,CV,SHR,PS,HLOAD  7
           +RGAS,TGAS,ERRDP,ID1,ID2,ID3,IRP0,IRM,IRB,IRO,ALPH1,RELAXH,HMIN,HLOAD     8
           +CAVE,REHAVE,LP,C(5,42),CODE(5,42),DIFU(5,42),PAPZ(5,42),RE(5,42),HLOAD   9
           +SRR(5,42),UBAR(5,42),WBAR(5,42),XK(5,42),RELAX,DELXB(5,42),HLOAD      10
           +ZK(5,42),PAPL(5,42),PP(5,42),DELXA(42),DELZA(42),U9,DELZB(5),QLX HLOAD  11
           +(42),QMX(42),QRX(42),QLZ(5),QMZ(5),QRZ(5),OP(5,42),OOP(5,42),HLOAD     12
           +X(5,42),P(5,42)                                             HLOAD      13
            NC=NN/NODFL2+1                                              HLOAD      14
            L(1)=NN                                                     HLOAD      15
            L(2)=NA                                                     HLOAD      16
            L(3)=NC-1                                                   HLOAD      17
            L(4)=NA-1                                                   HLOAD      18
            DO 50 I=1,NC                                                HLOAD      19
            XX(I)=X1+(X2-X1)/(NC-1)*(I-1)                               HLOAD      20
       50   CONTINUE                                                    HLOAD      21
            K=1                                                         HLOAD      22
            DO 60 J=1,NA                                                HLOAD      23
            DO 60 I=1,NN                                                HLOAD      24
            PARRAY(K)=P(J,I+1)                                          HLOAD      25
            XARRAY(K)=X(J,I+1)                                          HLOAD      26
       60   K=K+1                                                       HLOAD      27
     C                                                                  HLOAD      28
     C      CALCULATION OF UL(X) BY TRAPEZODIAL RULE                    HLOAD      29
     C                                                                  HLOAD      30
            NAM1=NA-1                                                   HLOAD      31
            AZD=(ZD(NA)-ZD(1))/NAM1                                     HLOAD      32
            DO 590 I=1,NC                                               HLOAD      33
            ADD=0.                                                      HLOAD      34
            DO 599 J=1,NAM1                                             HLOAD      35
            P1=DIABX(XARRAY,PARRAY,ZD,XX(I),ZD(J+1),L)-P(1,2)           HLOAD      36
            P2=DIABX(XARRAY,PARRAY,ZD,XX(I),ZD(J),L)-P(1,2)             HLOAD      37
            IF(P1.LT.0.)P1=0.                                           HLOAD      38
            IF(P2.LT.0.)P2=0.                                           HLOAD      39
            ADD=ADD+(AZD/2.)*(P1+P2)                                    HLOAD      40
      599   CONTINUE                                                    HLOAD      41
            FAC=1.                                                      HLOAD      42
            IF(IRC.EQ.3)FAC=2.                                          HLOAD      43
            UL(I)=ADD*FAC                                               HLOAD      44
       411  FORMAT(1X,F10.5,I5)                                         HLOAD      45
      590   CONTINUE                                                    HLOAD      46
     C                                                                  HLOAD      47
     C                                                                  HLOAD      48
     C      CALCULATION OF G(X) BY TRAPEZODIAL RULE                     HLOAD      49
     C                                                                  HLOAD      50
            N=NC                                                        HLOAD      51
            AH=(XX(N)-XX(1))/(N-1)                                      HLOAD      52
            G(I)=0.                                                     HLOAD      53
            SUM=0.                                                      HLOAD      54
            NM1=N-1                                                     HLOAD      55
            DO 100 I=1,NM1                                              HLOAD      56
            SUM=SUM+(AH/2.)*(UL(I)+UL(I+1))                             HLOAD      57
            IP1=I+1                                                     HLOAD      58
```



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```
                      G(IP1)=SUM                                                    HLOAD   59
                  100 CONTINUE                                                      HLOAD   60
                                                                                    HLOAD   61
   60             C                                                                 HLOAD   62
                  C     CALCULATION OF INTEGRAL OF  G(X) BY SIMPSONS RULE           HLOAD   63
                  C                                                                 HLOAD   64
                  C     IF N=ODD USE 1/3 RULE                                       HLOAD   65
                  C     IF N=EVEN USE 1/3 RULE + TRAPEZODIAL RULE FOR REMAINING AREA HLOAD  66
   65             C                                                                 HLOAD   67
                  C                                                                 HLOAD   68
                  C     DETERMINATION IF N IS OUD(GO TO 200) OR EVEN(GO TO 300)     HLOAD   69
                  C                                                                 HLOAD   70
                        NM2=N-2                                                     HLOAD   71
   70                   ZZ=N                                                       HLOAD   72
                        PA=ZZ/2.                                                    HLOAD   73
                        I=PA                                                        HLOAD   74
                        AI=I                                                        HLOAD   75
                        IF(AI-PA)200,300,200                                        HLOAD   76
   75             C                                                                 HLOAD   77
                  C     N IS ODD USE SIMPSONS 1/3 RULE                              HLOAD   78
                  C                                                                 HLOAD   79
                    200 AUD=0.                                                      HLOAD   80
                    299 FORMAT(1X,* SIMPSONS 1/3 RULE *,//)                         HLOAD   81
   80                   DO 250 I=1,NM2,2                                           HLOAD   82
                        AUD=AUD+(AH/3.)*(G(I)+(4.*G(I+1))+G(I+2))                   HLOAD   83
                    250 CONTINUE                                                    HLOAD   84
                        AINT=AUD/(XX(N)-XX(1))                                      HLOAD   85
                        GO TO 999                                                   HLOAD   86
   85             C                                                                 HLOAD   87
                  C     N IS EVEN USE SIMPSONS 1/3 RULE + TRAP. RULE FOR REMAINING AREA HLOAD 88
                  C                                                                 HLOAD   89
                    300 AUD=0.                                                      HLOAD   90
                    399 FORMAT(1X,* SIMPSONS 1/3 RULE PLUS TRAPEZODIAL RULE FOR REMAINING HLOAD 91
                       1AREA *)                                                     HLOAD   92
   90                   DO 350 I=1,NM2,2                                           HLOAD   93
                        AUD=AUD+(AH/3.)*(G(I)+(4.*G(I+1))+G(I+2))                   HLOAD   94
                    350 CONTINUE                                                    HLOAD   95
                        AUD=AUD+(AH/2.)*(G(N)+G(N-1))                               HLOAD   96
   95                   AINT=AUD/(XX(N)-XX(1))                                     HLOAD   97
                    999 F1=-G(1)+AINT                                               HLOAD   98
                        F2=G(N)-AINT                                                HLOAD   99
                        FT=F1+F2                                                    HLOAD  100
                   1000 FORMAT(1H1,1X,* LOAD AT XMIN = *,F10.3,* LBS.*,10X,* LOAD AT XMAX HLOAD 101
  100                  1= *,F10.3,* LBS. *,//)                                    HLOAD  102
                   1100 FORMAT(/,1X,* EQUILIBRIUM CHECK*,/)                         HLOAD  103
                   1200 FORMAT(1X,* THE SUMMATION OF FORCES = *,F10.3,10X,*THE INTEGRATED HLOAD 104
                       1PRESSURE LOAD = *,F10.3,//)                                 HLOAD  105
                    900 FORMAT(5F20.12)                                             HLOAD  106
  105                   RETURN                                                    HLOAD  107
                        END
```



82500

```
      FUNCTION DTABX(XTAB,YTAB,ZTAB,X,Z,L)                                  DTABX    2
1     DIMENSION XTAB(2),ZTAB(9),YTAB(2),L(4),LL(8),LM(8),DUMMX(20),DUMMY    DTABX    3
     +(20)                                                                  DTABX    4
                                                                            DTABX    5
C                                                                           DTABX    6
5     C     L(1) = NUMBER OF PAIRS OF POINTS PER LINE                       DTABX    7
      C     L(2) = NUMBER OF LINES                                          DTABX    8
      C     L(3) = DEGREE OF LAGRANGE INTERPOLATION ALONG LINE              DTABX    9
      C     L(4) = DEGREE OF LAGRANGE INTERPOLATION BETWEEN LINES           DTABX   10
      C     XTAB = ARRAY OF X VALUES                                        DTABX   11
10    C     YTAB = ARRAY OF Y VALUES                                        DTABX   12
      C     ZTAB = ARRAY OF Z VALUES                                        DTABX   13
      C     X = PRIMARY INDEPENDENT VARIABLE                                DTABX   14
      C     Z = SECONDARY INDEPENDENT VARIABLE                              DTABX   15
      C     DTAB = DEPENDENT VARIABLE                                       DTABX   16
15    C                                                                     DTABX   17
      LL(1)=L(1)                                                            DTABX   18
      LL(2)=L(3)                                                            DTABX   19
C                                                                           DTABX   20
C     CHECK TO SEE IF ONLY ONE LINE HAS BEEN INPUT                          DTABX   21
20    C                                                                     DTABX   22
      K=L(2)                                                                DTABX   23
      IF (L(2)-1)20,10,20                                                   DTABX   24
   10 DTAB=IABX(XTAB,YTAB,X,LL)                                             DTABX   25
C                                                                           DTABX   26
25    C     ONLY ONE LINE HAS BEEN INPUT                                    DTABX   27
      C                                                                     DTABX   28
      DTABX=DTAB                                                            DTABX   29
      RETURN                                                                DTABX   30
   20 CONTINUE                                                              DTABX   31
30    C                                                                     DTABX   32
      C     MORE THAN ONE LINE HAS BEEN INPUT.  NOW CHECK TO SEE IF Z LIES ON DTABX   33
      C     A LINE ZTAB(I)                                                  DTABX   34
      C                                                                     DTABX   35
      C     IF IT DOES, THE CORRECT LINE IS INTERPOLATED                    DTABX   36
35    C                                                                     DTABX   37
      C     IF IT DOES NOT, A DUMMY ARRAY IS GENERATED WHERE A DUMMY X      DTABX   38
      C     IS GENERATED FOR EACH LINE, AND A DUMMY Y CORRESPONDING TO      DTABX   39
      C     X FOR THAT LINE.  THE RESULTANT LINE ARRAY IS THEN INTERPOLATED DTABX   40
      C                                                                     DTABX   41
40    CALL BISC(ZTAB,Z,L(2),KBOTM,KTOP,JJ)                                  DTABX   42
      IF (JJ-1)30,80,80                                                     DTABX   43
   30 IF (KTOP-KBOTM)80,80,40                                               DTABX   44
   40 CONTINUE                                                              DTABX   45
      NORDE=L(4)                                                            DTABX   46
45    ICKCGT=NORDE                                                          DTABX   47
      IF (ICKCGT.LE.1)GO TO 80                                              DTABX   48
      IF (ICKCGT.GE.3)GO TO 70                                              DTABX   49
      GO TO (80,50,70),ICKCGT                                               DTABX   50
   50 KTOP=KTOP+1                                                           DTABX   51
50    IF (KTOP-K)80,80,60                                                   DTABX   52
   60 KTOP=K                                                                DTABX   53
      KBOTM=MAX0((KBOTM-1),1)                                               DTABX   54
      GO TO 80                                                              DTABX   55
   70 KTOP=MIN0((KTOP+1),L(2))                                              DTABX   56
55    KBOTM=MAX0((KBOTM-1),1)                                               DTABX   57
   80 CONTINUE                                                              DTABX   58
      IF (KBOTM.GT.KTOP)GO TO 5
```



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```
                      DO 110 I=KBOTM,KTOP                                    DTABX    59
                      LIN=L(1)*(I-1)+1                                       DTABX    60
   60                 TEST=ABS(Z-ZTAB(I))                                    DTABX    61
                      IF (TEST-0.000001)90,90,100                            DTABX    62
                   90 CONTINUE                                               DTABX    63
                      DTABX=TABX(XTAB(1),YTAB(LIN),X,LL)                     DTABX    64
                C                                                            DTABX    65
   65           C     Z LIES ON A LINE ZTAB(I)                               DTABX    66
                C                                                            DTABX    67
                      RETURN                                                 DTABX    68
                  100 CONTINUE                                               DTABX    69
                      DUMMX(I-KBOTM+1)=ZTAB(I)                               DTABX    70
   70                 DUMMY(I-KBOTM+1)=TABX(XTAB(1),YTAB(LIN),X,LL)          DTABX    71
                  110 CONTINUE                                               DTABX    72
                    5 CONTINUE                                               DTABX    73
                      LM(1)=KTOP-KBOTM+1                                     DTABX    74
                      LM(2)=L(4)                                             DTABX    75
   75                 DTABX=TABX(DUMMX,DUMMY,Z,LM)                           DTABX    76
                      RETURN                                                 DTABX    77
                      END                                                    DTABX    78
```

CARD NR. SEVERITY DETAILS DIAGNOSIS OF PROBLEM

48 I AN IF STATEMENT MAY BE MORE EFFICIENT THAN A 2 OR 3 BRANCH COMPUTED GO TO STATEMENT.

```
      FUNCTION TABX (XTAB,YTAB,O,L)                                  DTABX    79
      DIMENSION XTAB(2), YTAB(2), L(2)                               DTABX    80
      K=L(1)                                                         DTABX    81
      IF (K.GT.1) GO TO 10                                           DTABX    82
 5    TABX=YTAB(1)                                                   DTABX    83
      RETURN                                                         DTABX    84
   10 CALL BISC (XTAB,O,K,KBOTM,KTOP,JJ)                             DTABX    85
      IF (JJ.GE.1) GO TO 30                                          DTABX    86
      IF (KTOP.LE.KBOTM) GO TO 30                                    DTABX    87
10    NORDE=L(2)                                                     DTABX    88
      NORDE=MIN0(L(2),(K-1))                                         DTABX    89
      IF ((NORDE).LE.1) GO TO 30                                     DTABX    90
      IF ((NORDE).GE.3) GO TO 20                                     DTABX    91
      KTOP=KTOP+1                                                    DTABX    92
15    IF (KTOP.LE.K) GO TO 30                                        DTABX    93
      KTOP=K                                                         DTABX    94
      GO TO 30                                                       DTABX    95
   20 KTOP=MIN0((KTOP+1),K)                                          DTABX    96
      KBOTM=MAX0((KBOTM-1),1)                                        DTABX    97
20    30 Z=0.                                                        DTABX    98
      DO 60 J=KBOTM,KTOP                                             DTABX    99
      P=1.0                                                          DTABX   100
      DO 50 I=KBOTM,KTOP                                             DTABX   101
      IF (I.NE.J) GO TO 40                                           DTABX   102
25    P=P*YTAB(J)                                                    DTABX   103
      GO TO 50                                                       DTABX   104
   40 P=P*(O-XTAB(I))/(XTAB(J)-XTAB(I))                              DTABX   105
   50 CONTINUE                                                       DTABX   106
   60 Z=Z+P                                                          DTABX   107
30    TABX=Z                                                         DTABX   108
      RETURN                                                         DTABX   109
      END                                                            DTABX   110
```



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```
      SUBROUTINE BISC (Y,X,N,IL,IH,J)                                   DTABX  111
C ROUTINE TO SEARCH A VECTOR Y OF N VALUES TO FIND THE VALUES Y(IL)      DTABX  112
C     AND Y(IH) WHICH BRACKET THE NUMBER X.  IL IS LESS THAN IH.        DTABX  113
C     IF X = Y(I), IL = IH = I.                                         DTABX  114
C     IF X IS NOT IN RANGE, IL = IH = 1 IF NEAREST Y(1), OTHERWISE = N. DTABX  115
C                                                                       DTABX  116
      DIMENSION Y(2)                                                    DTABX  117
      J=0                                                               DTABX  118
      S=1.                                                              DTABX  119
      S=SIGN(S,Y(N)-Y(1))                                               DTABX  120
      IL=1                                                              DTABX  121
      IH=N                                                              DTABX  122
      I=1                                                               DTABX  123
      IF (S*(X-Y(1))) 20,60,10                                          DTABX  124
   10 I=N                                                               DTABX  125
      IF (S*(X-Y(N))) 40,60,30                                          DTABX  126
C     RETURN       IF NUMBER NOT IN TABLE.                              DTABX  127
   20 IH=MIN0(2,N)                                                      DTABX  128
      J=1                                                               DTABX  129
      RETURN                                                            DTABX  130
   30 IL=MAX0((N-1),1)                                                  DTABX  131
      J=2                                                               DTABX  132
      RETURN                                                            DTABX  133
   40 I=(IL+IH)/2                                                       DTABX  134
      IF (S*(X-Y(I))) 50,60,70                                          DTABX  135
   50 IH=I                                                              DTABX  136
      GO TO 80                                                          DTABX  137
   60 IL=I                                                              DTABX  138
      IH=I                                                              DTABX  139
      RETURN                                                            DTABX  140
   70 IL=I                                                              DTABX  141
   80 IF (IL+1-IH) 40,90,90                                             DTABX  142
   90 RETURN                                                            DTABX  143
      END                                                               DTABX  144
```



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```
      OVERLAY(ISOFR1,5,1)                                                START     2
      PROGRAM START                                                      START     3
      COMMON/SYMSOL/NN,MM,NNPE,NDOF,NVECT,NODES                          START     4
      COMMON/CURBMZ/DUM(38),FNOA(160)                                    START     5
      COMMON/FOILLY/IFOIL,NODFL,N,M,N1,N2,M1,M2                          START     6
      COMMON/HOLEH/H2(5,82),Y2(5,82),C2(5,82),BETA2(82),NE,ME,NE1,NE2,   START     7
     +ME1,ME2                                                            START     8
      COMMON/ITER/ITERATE,LIM,ERROR                                      START     9
      COMMON S(1),RECR,PV,KNOT,INPP,INCF,FILMP,DZD,BETA(42),Q(5,42),     START    10
     +P(5,42),U(5,42),ALPHO(5),E(5),EDOT(5),ALPHA(5),ZD(5),RHO,AU,       START    11
     +H(5,42),ERRA,IRC,PHRM,PBR1,NSB,IEXT,VARPS,VARA,VARDY,AD,CV,SHR,PS, START    12
     +RGAS,IGAS,ERRUP,ID1,ID2,ID3,IRPO,IRM,IRB,IRO,ALPH1,RELAXH,HMIN,    START    13
     +CAVE,REHAVE,LP,C(5,42),CODE(5,42),DIFU(5,42),PAPZ(5,42),RE(5,42),  START    14
     +SHR(5,42),UBAR(5,42),WBAR(5,42),XK(5,42),RELAX,DELXB(5,42),        START    15
     +ZK(5,42),PAPL(5,42),PP(5,42),DELXA(42),DELZA(42),U9,DELZB(5),QLX   START    16
     +(42),QMX(42),QRX(42),QLZ(5),QMZ(5),QRZ(5),OP(5,42),OOP(5,42),      START    17
     +X(5,42),R(5,42)                                                    START    18
      COMMON/L/AXLEN                                                     START    19
      COMMON/RT/RK,R,RS,T                                                START    20
      COMMON/EC/E1,PSI                                                   START    21
      COMMON/PDEL/RX(160),RF(162),RSP(160)                               START    22
      COMMON/KEY/NODEE(82),NODEH(160)                                    START    23
C                                                                        START    24
      CALL MEMSET(S,P(5,42),^,)                                          START    25
C       FILL KEY ARRAYS FOR CORRESPONDENCE BETWEEN NODE                  START    26
C       NUMBERING SYSTEMS AND LOAD ANGLES.                               START    27
      CALL MEMSET(NODEE(1),NODEH(160),0)                                 START    28
      J=1                                                                START    29
      WRITE(61,2010)                                                     START    30
      DO 10 I=1,IFOIL                                                    START    31
      K1=(I-2)*NODFL+NODFL/2+1                                           START    32
      IF(I.EQ.1)K1=NODES-NODFL/2+1                                       START    33
      K2=(I-1)*NODFL                                                     START    34
      IF(I.EQ.1)K2=NODES                                                 START    35
      DO 10 K=K1,K2                                                      START    36
      BETA2(J+1)=FNOA(K)                                                 START    37
      IF(I.EQ.1)BETA2(J+1)=BETA2(J+1)-4.*ASIN(1.0)                       START    38
      NODEE(J+1)=K                                                       START    39
      NODEH(K)=J+1                                                       START    40
      L=J+1                                                              START    41
      WRITE(61,19)L,NODEE(L),K,NODEH(K),BETA2(L)                         START    42
   19 FORMAT(1H *NODEE(*,I3,*)=*,I3,3X,*NODEH(*,I3,*)=*,I3,E15.5)        START    43
   10 J=J+1                                                              START    44
      NE=J-1                                                             START    45
      NE1=NE+1                                                           START    46
      NE2=NE+2                                                           START    47
      NODEE(1)=NODEE(NE1)                                                START    48
      NODEE(NE2)=NODEE(2)                                                START    49
      PI=3.14159                                                         START    50
      A=ASIN(E1*SIN(PI-PSI)/SQRT(E1**2+RS**2-2.*E1*RS*COS(PI-PSI)))      START    51
      B=PI-PSI                                                           START    52
      PSIP=PI-A+B                                                        START    53
      ALPH1=PSIP*180./PI+180.                                            START    54
      IF(ALPH1.GE.360.)ALPH1=ALPH1-360.                                  START    55
      KNOT=1                                                             START    56
      WRITE(61,1990)                                                     START    57
C       READ IDENTIFICATION CARD 1                                       START    58
```

```
                      READ(60,2000)                                                  START   59
                      IF(EOF(60))30,40                                               START   60
60                30  STOP                                                         START   61
                  40  WRITE(61,2000)                                                START   62
                      WRITE(61,2010)                                                 START   63
                  C    READ CARDS 2,3,4,5                                          START   64
                      READ(60,2020)RHO,U9,RZD,RELAXH,ERROR                           START   65
                      READ (60,2030)PBR1,PBRM,FILMP,ERRDP,RELAX,EXT,ERRA             START   66
65                    READ (60,2020)S,FRACS,EC,EDOT1,ALPH1,ALPHD1                    START   67
                      READ (60,2040)M,N,KNOT,LP,NSB,INP,INCF,INPP,IRC,IRPO,IRO,IRM,IRP,I START   68
                     +RB,IRZ,ID1,ID2,ID3                                             START   69
                      NSB=360/IFOIL                                                  START   70
70                    NOOFL2=N                                                       START   71
                      KNOT=1                                                         START   72
                      WRITE (61,2050)                                                START   73
                      WRITE (61,2060)R,RS,RHO,U9,RZD,AXLEN,PBR1,PBRM                 START   74
                      WRITE (61,2070)                                                START   75
                      WRITE (61,2060)FILMP,ERRDP,S,FRACS,E1,EDOT1,ALPH1,ALPHD1       START   76
75                    WRITE (61,2080)                                                START   77
                      WRITE (61,2090)M,N,KNOT,LP,NSB,INP,INCF,INPP,IRC,IRPO,IRO,IRM,IRP, START   78
                     +IRB,IRZ,ID1,ID2,ID3                                            START   79
                      IF (ERRA)50,50,60                                              START   80
80                 50 WRITE (61,2100)                                                START   81
                      WRITE (61,2110)RELAX,EXT                                       START   82
                      GO TO 70                                                       START   83
                   60 WRITE (61,2120)                                                START   84
                      WRITE (61,2130)RELAX,EXT,ERRA                                  START   85
85                 70 IF (IRC-3)90,80,90                                             START   86
                   80 AXLEN=AXLEN/2.                                                 START   87
                   90 KPRESS=1                                                       START   88
                      KFRIC=1                                                        START   89
                      IEXT=EXT                                                       START   90
                      C9=R-RS                                                        START   91
90                    RECR=41.1*SQRT(R/C9)                                           START   92
                      VARA=0.                                                        START   93
                      VARPS=0.                                                       START   94
                      VARDY=0.                                                       START   95
                      ICKCGT=IRPO                                                    START   96
95                    IF (ICKCGT.LE.1)GO TO 100                                      START   97
                      IF (ICKCGT.GE.3)GO TO 100                                      START   98
                      GO TO (100,110,100),ICKCGT                                     START   99
                  100 READ (60,2140)VARA,VARPS,VARDY                                 START   100
                      WRITE (61,2150)                                                START   101
100                   WRITE (61,2160)VARA,VARPS,VARDY                                START   102
                  110 ICKCGT=IRO                                                     START   103
                      IF (ICKCGT.LE.1)GO TO 120                                      START   104
                      IF (ICKCGT.GE.2)GO TO 130                                      START   105
                      GO TO (120,130),ICKCGT                                         START   106
105                 120 READ (60,2170)AD,CV,SHR,PS,RGAS,TGAS                         START   107
                      WRITE (61,2180)                                                START   108
                      WRITE (61,2190)AD,CV,SHR,PS,RGAS,TGAS                          START   109
                      AO=3.14159*((AD/2.)**2)                                        START   110
110                 130 KNOT=KNOT+1                                                  START   111
                      ERRDP=ERRDP/100.                                               START   112
                      SUMP2=0.                                                       START   113
                      SUMP1=0.                                                       START   114
                      SUMT=0.                                                        START   115
```

```
                N1=N+1                                                          START     116
                N2=N+2                                                          START     117
                M1=M-1                                                          START     118
                M2=M-2                                                          START     119
                ME=M                                                            START     120
                ME1=ME-1                                                        START     121
                ME2=ME-2                                                        START     122
                M1=M-1                                                          START     123
                M2=M-2                                                          START     124
                BETA2(1)=BETA2(NE1)                                             START     125
                BETA2(NE2)=BETA2(2)                                             START     126
                IF (KNOT-N1)150,150,140                                         START     127
              140 KNOT=2                                                        START     128
              150 ICKCGT=IRC                                                    START     129
                  IF (ICKCGT.LE.1)GO TO 160                                     START     130
                  IF (ICKCGT.GE.3)GO TO 170                                     START     131
                  GO TO (160,170,170),ICKCGT                                    START     132
              160 READ (60,2250)XO,YO,THETA,XOP,YOP,THETAP                      START     133
                  WRITE (61,2200)                                               START     134
                  WRITE (61,2210)XO,YO,THETA,XOP,YOP,THETAP                     START     135
C                 GENERATE CONSTANT MATRIX VALUES                               START     136
              170 IF (1.GT.M)GO TO 5                                            START     137
C             ****************  NOTE DO NEST--OUTER MOST DO CHECKED ONLY  ********* START     138
              161   FORMAT(1H0,*C9=*,E10.4)                                     START     139
              162   FORMAT(1H0,5(E10.4,1X))                                     START     140
                  EPSILON=0.001                                                 START     141
                  DO 199 I=1,ME                                                 START     142
                  DO 199 J=2,NE1                                                START     143
                  C2(I,J)=RF(NODEE(J))-RS+EPSILON                               START     144
                  X2(I,J)=RS*BETA2(J)                                           START     145
              199 CONTINUE                                                      START     146
                  DO 200 I=1,M                                                  START     147
                  DO 200 J=2,N1                                                 START     148
                  ICKCGT=INP                                                    START     149
                  IF (ICKCGT.LE.1)GO TO 180                                     START     150
                  IF (ICKCGT.GE.2)GO TO 190                                     START     151
                  GO TO (180,190),ICKCGT                                        START     152
              180 P(I,J)=PBRM                                                   START     153
              190 CONTINUE                                                      START     154
                  IP(I,J)=0                                                     START     155
              200 U(I,J)=U9                                                     START     156
                5 CONTINUE                                                      START     157
C                 GENERATE BOUNDARY PRESSURE ROW 1 ROW M                        START     158
                  IF (1.GT.N2)GO TO 25                                          START     159
                  DO 240 J=1,N2                                                 START     160
                  P(1,J)=PBR1                                                   START     161
                  IF (IRC-3)210,220,210                                         START     162
              210 IP(1,J)=1                                                     START     163
                  GO TO 230                                                     START     164
              220 IP(1,J)=0                                                     START     165
              230 IP(M,J)=1                                                     START     166
              240 P(M,J)=PBRM                                                   START     167
               25 CONTINUE                                                      START     168
C                 GENERATE BOUNDARY PRESSURES  COLUMN 1 COLUMN J                START     169
                  IF(NSW-360)250,270,250                                        START     170
              250 IF (1.GT.M)GO TO 35                                           START     171
                  DO 260 I=1,M                                                  START     172
```

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                P(I,2)=PBR1                                                     START     173
                IP(I,2)=1                                                       START     174
                P(I,N1)=PBR1                                                    START     175
  175         260 IP(I,N1)=1                                                    START     176
               35 CONTINUE                                                      START     177
              270 ICKCGT=IRM                                                    START     178
                  IF (ICKCGT.LE.1)GO TO 280                                     START     179
                  IF (ICKCGT.GE.2)GO TO 290                                     START     180
  180             GO TO (280,290),ICKCGT                                        START     181
                C     READ ALL OF CARDS WITH UNIQUE MATRIX VALUE  CARDS NO. 8   START     182
              280 READ (60,2220)I,J,P(I,J+1),C(I,J+1),U(I,J+1),IP(I,J+1),NEXT   START     183
                  ICKCGT=NEXT                                                   START     184
                  IF (ICKCGT.LE.1)GO TO 280                                     START     185
  185             IF (ICKCGT.GE.2)GO TO 290                                     START     186
                  GO TO (280,290),ICKCGT                                        START     187
                C     READ INTERNAL BOUNDARY POINTS                             START     188
                290   ICKCGT=IRP                                                START     189
                  IF(ICKCGT.LE.1)GO TO 300                                      START     190
  190             IF(ICKCGT.GE.2)GO TO 310                                      START     191
                  GO TO(300,310),ICKCGT                                         START     192
                300   READ(60,2230)(I,J,P(I,J+1),IP(I,J+1),NEXT)                START     193
                  ICKCGT=NEXT                                                   START     194
                  IF(ICKCGT.LE.1)GO TO 300                                      START     195
  195             IF(ICKCGT.GE.2)GO TO 310                                      START     196
                C     COLUMN 2 TO COLUMN N+2   COLUMN N+1 TO COLUMN 1           START     197
                310 IF (1.GT.M)GO TO 45                                         START     198
                    DO 320 I=1,M                                                START     199
                    P(I,1)=P(I,N1)                                              START     200
  200               P(I,N2)=P(I,2)                                              START     201
                    IP(I,1)=IP(I,N1)                                            START     202
                    IP(I,N2)=IP(I,2)                                            START     203
                    C(I,1)=C(I,N1)                                              START     204
                    C(I,N2)=C(I,2)                                              START     205
  205               U(I,1)=U(I,N1)                                              START     206
                320 U(I,N2)=U(I,2)                                              START     207
                    DO 323 I=1,ME                                               START     208
                    C2(I,1)=C2(I,NE1)                                           START     209
                    C2(I,NE2)=C2(I,2)                                           START     210
  210             323 CONTINUE                                                  START     211
                 45 CONTINUE                                                    START     212
                    ICKCGT=IRB                                                  START     213
                    IF (ICKCGT.LE.1)GO TO 330                                   START     214
                    IF (ICKCGT.GE.2)GO TO 360                                   START     215
  215               GO TO (330,360),ICKCGT                                      START     216
                330 READ (60,2240)(BETA(J),J=2,N1)                              START     217
                    WRITE (61,2240)(BETA(J),J=2,N1)                             START     218
                    IF (2.GT.N1)GO TO 55                                        START     219
                    DO 340 J=2,N1                                               START     220
  220               340 BETA(J)=(3.1416*BETA(J))/180.                           START     221
                 55 CONTINUE                                                    START     222
                    KNOT=1                                                      START     223
                    IF (2.GT.N1)GO TO 65                                        START     224
                    DO 350 J=2,N1                                               START     225
  225               KNOT=KNOT+1                                                 START     226
                    IF (BETA(J))350,450,350                                     START     227
                350 CONTINUE                                                    START     228
                 65 CONTINUE                                                    START     229
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                GO TO 450                                                       START  230
C               CALCULATE BETA VALUES FOR EACH COLUMN                           START  231
  360           FLON=N                                                          START  232
                FNSB=NSB                                                        START  233
                IF (NSB-360)370,380,370                                         START  234
  370           DELTB=(FNSB*3.1416)/((FLON-1.)*180.)                            START  235
                GO TO 390                                                       START  236
  380           DELTB=6.2831P/FLON                                              START  237
  390           IF (2.GT.N1)GO TO 75                                            START  238
                DO 440 J=2,N1                                                   START  239
                IF (J-KNOT)410,400,410                                          START  240
  400           BETA(J)=0.                                                      START  241
                GO TO 440                                                       START  242
  410           FLOJ=FLOAT(J)                                                   START  243
                FLOK=FLOAT(KNOT)                                                START  244
                IF (J-KNOT)420,440,430                                          START  245
  420           BETA(J)=6.28318-((FLOK-FLOJ)*DELTB)                             START  246
                GO TO 440                                                       START  247
  430           BETA(J)=(FLOJ-FLOK)*DELTB                                       START  248
  440           CONTINUE                                                        START  249
   75           CONTINUE                                                        START  250
  450           BETA(N2)=BETA(2)                                                START  251
                BETA(1)=BETA(N1)                                                START  252
                ICKCGT=IRZ                                                      START  253
                IF (ICKCGT.LE.1)GO TO 460                                       START  254
                IF (ICKCGT.GE.2)GO TO 470                                       START  255
                GO TO (460,470),ICKCGT                                          START  256
  460           READ (60,2020)(ZD(I),I=1,M)                                     START  257
                WRITE (61,2020)(ZD(I),I=1,M)                                    START  258
                GO TO 490                                                       START  259
C               GENERATE Z VALUES FOR EACH ROW                                  START  260
C               GENERATE Z VALUES FOR EACH ROW                                  START  261
  470           ZD(1)=RZD                                                       START  262
                DZD=AXLEN/FLOAT(M1)                                             START  263
                IF (2.GT.M)GO TO 85                                             START  264
                DO 480 I=2,M                                                    START  265
                IM=I-1                                                          START  266
  480           ZD(I)=ZD(IM)+DZD                                                START  267
   85           CONTINUE                                                        START  268
  490           ICKCGT=IRO                                                      START  269
                IF (ICKCGT.LE.1)GO TO 500                                       START  270
                IF (ICKCGT.GE.2)GO TO 530                                       START  271
                GO TO (500,530),ICKCGT                                          START  272
  500           IF (1.GT.M)GO TO 95                                             START  273
                DO 520 I=1,M                                                    START  274
                IF (1.GT.N1)GO TO 105                                           START  275
                DO 520 J=1,N1                                                   START  276
                IF (IP(I,J)-1)510,520,510                                       START  277
  510           P(I,J)=PS                                                       START  278
  520           CONTINUE                                                        START  279
  105           CONTINUE                                                        START  280
   95           CONTINUE                                                        START  281
  530           ICKCGT=IRC                                                      START  282
                IF (ICKCGT.LE.1)GO TO 540                                       START  283
                IF (ICKCGT.GE.3)GO TO 580                                       START  284
                GO TO (540,560,580),ICKCGT                                      START  285
  540           IF (1.GT.M)GO TO 115                                            START  286
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                DO 570 I=1,M                                                    START     287
                DENAL=XO+(ZD(I)*THETA)                                          START     288
                ALPHA(I)=ATAN(YO/DENAL)                                         START     289
                IF (DENAL)550,560,560                                           START     290
290           550 ALPHA(I)=ALPHA(I)+3.14159                                     START     291
              560 E(I)=SQRT(((THETA**2)*(ZD(I)**2))+(2.*THETA*XO*ZD(I))+(XO*XO)+(YO*  START     292
                +YO))                                                           START     293
                ALPHD(I)=((ZD(I)*((THETA*YOP)-(YO*THETAP)))+((YOP*XO)-(XOP*YO)))/(  START     294
                +E(I)*E(I))                                                     START     295
295           570 EDOT(I)=((THETA*THETAP*ZD(I)*ZD(I))+(((XO*THETAP)+(THETA*XOP))*ZD(  START     296
                +I))+(XO*XOP)+(YO*YOP))/E(I)                                    START     297
              115 CONTINUE                                                      START     298
                GO TO 600                                                       START     299
              580 IF (1.GT.M)GO TO 125                                          START     300
300             DO 590 I=1,M                                                    START     301
                ALPHA(I)=(ALPH1*3.1416)/180.                                    START     302
                E(I)=E1                                                         START     303
                ALPHD(I)=(ALPHD1*3.1416)/30.                                    START     304
              590 EDOT(I)=EDOT1                                                 START     305
305           125 CONTINUE                                                      START     306
C               CONVERT TO CORRECT UNITS                                        START     307
              600 S=(S*3.1416)/30.                                              START     308
                RHO=RHO/386.04                                                  START     309
                PV=FRACS*S                                                      START     310
310             ERRA=(ERRA*3.14159)/180.                                        START     311
              634 CONTINUE                                                      START     312
              641 CONTINUE                                                      START     313
C               INITIATE FILM THICKNESS                                         START     314
                EPSILON=0.001                                                   START     315
315             DO 642 I=1,ME                                                   START     316
                DO 642 J=2,NE1                                                  START     317
                K=NODEE(J)                                                      START     318
                H2(I,J)=RF(K)-RSP(K)+EPSILON                                    START     319
              642 CONTINUE                                                      START     320
320             DO 643 I=1,M                                                    START     321
                H2(I,1)=H2(I,NE1)                                               START     322
                H2(I,NE2)=H2(I,2)                                               START     323
                X2(I,1)=X2(I,NE1)-2.*3.14159265*RS                              START     324
                X2(I,NE2)=X2(I,2)+2.*3.14159265*RS                              START     325
325             C2(I,1)=C2(I,NE1)                                               START     326
                C2(I,NE2)=C2(I,2)                                               START     327
              643 CONTINUE                                                      START     328
                WRITE(10)(S(I),I=1,474R)                                        START     329
                REWIND 10                                                       START     330
330           1990 FORMAT (43H HYDRODYNAMIC GAS OR LIQUID BEARING PROGRAM,///)  START     331
              2000 FORMAT (1X,71H                                               START     332
                +                    )                                        START     333
              2010 FORMAT (1H )                                                 START     334
              2020 FORMAT (6E12.3)                                              START     335
335           2030 FORMAT (5E12.3,2F6.0)                                        START     336
              2040 FORMAT (18I4)                                                START     337
              2050 FORMAT (120H RADIUS BEARING   RADIUS SHAFT        DENSITY      VIS START     338
                +COSITY  Z-DIST. TO CG   AXIAL LENGTH   PRESS. ROW 1   PRESS. ROW M START     339
                +)                                                              START     340
340           2060 FORMAT (8E15.6/)                                             START     341
              2070 FORMAT (120H MINIMUM PRESS.  ERROR LIMIT P     SPIN SPEED    START     342
                + WHIRL     ECC. RATIO   DERIVATIVE E    ANGLE ALPHA   DERIV. ALPHA START     343
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     +)                                                                                START     344
2080 FORMAT (120H ROWS COLS. BETA=0 LIM.P SHOE P TO 0 FLOW PRT.M READ C                START     345
    + READ POR READ O READ M READ P READ B READ Z FLOW 1 FLOW 2 FLOW 3                  START     346
     +)                                                                                START     347
2090 FORMAT (I5,I6,I7,I6,I5,I7,I5,I6,I7,I9,8I7/)                                       START     348
2100 FORMAT (46H RELAX(DELTA P)  NO. ITER. BEFORE EXTRAP. TEST)                        START     349
2110 FORMAT (E15.6,F31.0///)                                                           START     350
2120 FORMAT (70H RELAX(DELTA P)  NO. ITER. BEFORE EXTRAP. TEST   ALLOWA                START     351
    +BLE ERROR ALPHA)                                                                  START     352
2130 FORMAT (E15.6,F31.0,E24.5///)                                                     START     353
2140 FORMAT (3E12.3)                                                                   START     354
2150 FORMAT (60H         PERMEABILITY     SUPPLY PRESSURE  MATERIAL THIC               START     355
    +KNESS)                                                                            START     356
2160 FORMAT (3E20.6/)                                                                  START     357
2170 FORMAT (6E12.6)                                                                   START     358
2180 FORMAT (120H    ORIFICE DIAMETER    FLOW COEFFICIENT SPECIFIC HEAT                START     359
    + RATIO     SUPPLY PRESSURE      GAS CONSTANT-R      GAS CONSTANT-T                START     360
     +)                                                                                START     361
2190 FORMAT (6E20.6///)                                                                START     362
2200 FORMAT (120H              X SUB 0              Y SUB 0                            START     363
    + THETA  DERIVATIVE X SUB 0  DERIVATIVE Y SUB 0    DERIVATIVE THETA                START     364
     +)                                                                                START     365
2210 FORMAT (6E20.6//)                                                                 START     366
2220 FORMAT (2I5,3E12.3,I5,I2)                                                         START     367
2230 FORMAT (2I5,E12.3,I5,I2)                                                          START     368
2240 FORMAT (10F7.2)                                                                   START     369
2250 FORMAT (6E12.3)                                                                   START     370
     END                                                                               START     371
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| CARD NR. | SEVERITY | DETAILS | DIAGNOSIS OF PROBLEM |
|---|---|---|---|
| 98 | I | | AN IF STATEMENT MAY BE MORE EFFICIENT THAN A 2 OR 3 BRANCH COMPUTED GO TO STATEMENT. |
| 105 | I | | AN IF STATEMENT MAY BE MORE EFFICIENT THAN A 2 OR 3 BRANCH COMPUTED GO TO STATEMENT. |
| 131 | I | | AN IF STATEMENT MAY BE MORE EFFICIENT THAN A 2 OR 3 BRANCH COMPUTED GO TO STATEMENT. |
| 151 | I | | AN IF STATEMENT MAY BE MORE EFFICIENT THAN A 2 OR 3 BRANCH COMPUTED GO TO STATEMENT. |
| 180 | I | | AN IF STATEMENT MAY BE MORE EFFICIENT THAN A 2 OR 3 BRANCH COMPUTED GO TO STATEMENT. |
| 186 | I | | AN IF STATEMENT MAY BE MORE EFFICIENT THAN A 2 OR 3 BRANCH COMPUTED GO TO STATEMENT. |
| 191 | I | | AN IF STATEMENT MAY BE MORE EFFICIENT THAN A 2 OR 3 BRANCH COMPUTED GO TO STATEMENT. |
| 195 | I | 310 | THIS IF DEGENERATES INTO A SIMPLE TRANSFER TO THE LABEL INDICATED. |
| 215 | I | | AN IF STATEMENT MAY BE MORE EFFICIENT THAN A 2 OR 3 BRANCH COMPUTED GO TO STATEMENT. |
| 255 | I | | AN IF STATEMENT MAY BE MORE EFFICIENT THAN A 2 OR 3 BRANCH COMPUTED GO TO STATEMENT. |
| 271 | I | | AN IF STATEMENT MAY BE MORE EFFICIENT THAN A 2 OR 3 BRANCH COMPUTED GO TO STATEMENT. |
| 284 | I | | AN IF STATEMENT MAY BE MORE EFFICIENT THAN A 2 OR 3 BRANCH COMPUTED GO TO STATEMENT. |
| 307 | I | S | ARRAY NAME OPERAND NOT SUBSCRIPTED, FIRST ELEMENT WILL BE USED. |
| 307 | I | S | ARRAY NAME OPERAND NOT SUBSCRIPTED, FIRST ELEMENT WILL BE USED. |
| 309 | I | S | ARRAY NAME OPERAND NOT SUBSCRIPTED, FIRST ELEMENT WILL BE USED. |
| 328 | I | | ARRAY REFERENCE OUTSIDE DIMENSION BOUNDS. |

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      OVERLAY(ISOFR1,5,2)                                                    HYDRO       2
C                                                                            HYDRO       3
      PROGRAM HYDRO                                                          HYDRO       4
C     ***************     PROGRAM 519  11-27-68     **************           HYDRO       5
      COMMON/SYMSOL/NN,MM,NNPE,NDOF,NVECT,NODES                              HYDRO       6
      COMMON/CURBMZ/DUM(38),FNOA(160)                                        HYDRO       7
      COMMON/FOILLY/IFOIL,NODFL,N,M,N1,N2,M1,M2                              HYDRO       8
      COMMON/ITER/ITERATE,LIM,ERROR                                          HYDRO       9
      COMMON S(1),RECR,PV,KNOT,INPP,INCF,FILMP,DZD,BETA(42),Q(5,42),         HYDRO      10
     +IP(5,42),U(5,42),ALPHD(5),E(5),EDOT(5),ALPHA(5),ZD(5),RHO,AO,          HYDRO      11
     +H(5,42),ERRA,IRC,PBRM,PBR1,NSB,IEXT,VARPS,VARA,VARDY,AD,CV,SHR,PS,     HYDRO      12
     +RGAS,TGAS,ERRDP,ID1,ID2,ID3,IRPO,IRM,IRB,IRO,ALPH1,RELAXH,HMIN,        HYDRO      13
     +CAVE,RHAVE,LP,C(5,42),CODE(5,42),DIFU(5,42),PAPZ(5,42),RE(5,42),       HYDRO      14
     +SRR(5,42),UBAR(5,42),WBAR(5,42),XK(5,42),RELAX,DELXB(5,42),           HYDRO      15
     +ZK(5,42),PAPL(5,42),PP(5,42),DELXA(42),DELZA(42),U9,DELZB(5),QLX      HYDRO      16
     +(42),QMX(42),QRX(42),QLZ(5),QMZ(5),QRZ(5),OP(5,42),OOP(5,42),         HYDRO      17
     +X(5,42),P(5,42)                                                       HYDRO      18
      COMMON/L/AXLEN                                                         HYDRO      19
      COMMON/RT/RK,R,RS,T                                                    HYDRO      20
      COMMON/EC/E1,PSI                                                       HYDRO      21
      COMMON/PDEL/PX(160),RF(162),RSP(160)                                   HYDRO      22
      COMMON/KEY/NODEE(82),NODEH(160)                                        HYDRO      23
      COMMON/INT/SAVER(5,82),SAVERB(82)                                      HYDRO      24
      DIMENSION X(5,82),CHOU(5,82)                                           HYDRO      25
      COMMON/FOR/HFORCES(160)                                                HYDRO      26
      DIMENSION FORCE(5,82)                                                  HYDRO      27
      CALL MEMSET(FORCE(1),FORCE(410),0.)                                    HYDRO      28
      HMIN=0.00001                                                           HYDRO      29
  610 CONTINUE                                                               HYDRO      30
C ****************  NOTE DO NEST--OUTER MOST DO CHECKED ONLY  *********      HYDRO      31
      EC=E1                                                                  HYDRO      32
      NODFL2=N                                                               HYDRO      33
      CAVE=(C(1,2)+C(1,N1))/2.                                               HYDRO      34
      C9=CAVE                                                                HYDRO      35
      RHAVE=((R-T)+RS)/2.                                                    HYDRO      36
      DO 689 I=1,M                                                           HYDRO      37
      DO 689 J=2,N1                                                          HYDRO      38
      CANG=COS(BETA(J)-ALPHA(I))                                             HYDRO      39
      SANG=SIN(BETA(J)-ALPHA(I))                                             HYDRO      40
      CONKT=(E(I)/(C9*R))                                                    HYDRO      41
      IF (CONKT-0.8)620,620,630                                              HYDRO      42
  620 CONK=0.3-(0.045*EXP((2.37*E(I))/(C9*R)))                               HYDRO      43
      GO TO 640                                                              HYDRO      44
  630 CONK=0.                                                                HYDRO      45
C     GENERATE MATRIX OF H,H CUBED OVER MU, 6R SUB R                         HYDRO      46
  640 CONTINUE                                                               HYDRO      47
      IF(H(I,J).LT.HMIN)H(I,J)=HMIN                                          HYDRO      48
  689 CONTINUE                                                               HYDRO      49
      DO 690 I=1,M                                                           HYDRO      50
      DO 690 J=2,N1                                                          HYDRO      51
      X(I,1)=X(I,N1)-2.*3.14159265*RS                                        HYDRO      52
      X(I,N2)=X(I,2)+2.*3.14159265*RS                                        HYDRO      53
      H(I,1)=H(I,N1)                                                         HYDRO      54
      H(I,N2)=H(I,2)                                                         HYDRO      55
      LMOD=MOD(J-1,NODFL2)                                                   HYDRO      56
      IF(LMOD.EQ.1)GO TO 644                                                 HYDRO      57
      IF(LMOD.EQ.0)GO TO 643                                                 HYDRO      58
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      PHPX=(H(I,J+1)-H(I,J-1))/(X(I,J+1)-X(I,J-1))                          HYDRO      59
      GO TO 645                                                             HYDRO      60
60    643 PHPX=(H(I,J-1)-H(I,J))/(X(I,J-1)-X(I,J))                          HYDRO      61
      GO TO 645                                                             HYDRO      62
      644 PHPX=(H(I,J+1)-H(I,J))/(X(I,J+1)-X(I,J))                          HYDRO      63
      SXF=XFX*DELXZ+SFX                                                     HYDRO      64
      645 CONTINUE                                                          HYDRO      65
65    CHOU(I,J)=(H(I,J)**(3))/U(I,J)                                        HYDRO      66
      DIFU(I,J)=((R-C(I,J))*S)+(C(I,J)*PV)+(E(I)*ALPHD(I)*CANG)-(EDOT(I)    HYDRO      67
     +*SANG)                                                                HYDRO      68
      RE(I,J)=(RHO*DIFU(I,J)*H(I,J))/U(I,J)                                 HYDRO      69
      IF (CONK)650,660,650                                                  HYDRO      70
70    650 IF (RE(I,J)-RECR)660,670,670                                      HYDRO      71
      660 XK(I,J)=1.                                                        HYDRO      72
      ZK(I,J)=1.                                                            HYDRO      73
      CODE(I,J)=1.                                                          HYDRO      74
      GO TO 680                                                             HYDRO      75
75    670 REK=CONK*CONK*RE(I,J)                                             HYDRO      76
      XK(I,J)=((REK**0.725)*(0.53/12.))+1.                                  HYDRO      77
      ZK(I,J)=(1.+(0.0247*(REK**0.65)))                                     HYDRO      78
      CODE(I,J)=2.                                                          HYDRO      79
      680 CONTINUE                                                          HYDRO      80
80    TERM1=PHPX*(RS*(S-PV)+(RS+C(I,J))*PV+E(I)*ALPHD(I)*CANG-EDOT(I        HYDRO      81
     +)*SANG)                                                               HYDRO      82
      TERM2=H(I,J)*(E(I)/RS*ALPHD(I)*SANG+EDOT(I)/RS*CANG)                  HYDRO      83
      TERM3=-2.*(RS+C(I,J))*PV*E(I)/(RS+C(I,J))*SANG-2.*EDOT(I)*CANG        HYDRO      84
     +-2.*EDOT(I)*ALPHD(I)*SANG                                             HYDRO      85
85    SRR(I,J)=6.*(TERM1+TERM2+TERM3)                                       HYDRO      86
      690 CONTINUE                                                          HYDRO      87
      991 FORMAT(1H ,*I,J,PHPX,SRR =*,2I6,2E15.5)                           HYDRO      88
      135 CONTINUE                                                          HYDRO      89
      IF (1.GT.M)GO TO 155                                                  HYDRO      90
90    DO 700 I=1,M                                                          HYDRO      91
      CHOU(I,1)=CHOU(I,N1)                                                  HYDRO      92
      CHOU(I,N2)=CHOU(I,2)                                                  HYDRO      93
      SRR(I,1)=SRR(I,N1)                                                    HYDRO      94
      SRR(I,N2)=SRR(I,2)                                                    HYDRO      95
95    XK(I,1)=XK(I,N1)                                                      HYDRO      96
      XK(I,N2)=XK(I,2)                                                      HYDRO      97
      ZK(I,1)=ZK(I,N1)                                                      HYDRO      98
      ZK(I,N2)=ZK(I,2)                                                      HYDRO      99
      DIFU(I,1)=DIFU(I,N1)                                                  HYDRO     100
100   DIFU(I,N2)=DIFU(I,2)                                                  HYDRO     101
      H(I,1)=H(I,N1)                                                        HYDRO     102
      700 H(I,N2)=H(I,2)                                                    HYDRO     103
      155 CONTINUE                                                          HYDRO     104
      IF (2.GT.M1)GO TO 165                                                 HYDRO     105
105   DO 710 I=2,M1                                                         HYDRO     106
      IN=I+1                                                                HYDRO     107
      IM=I-1                                                                HYDRO     108
      DELZA(I)=(ZD(I)-ZD(IM))                                               HYDRO     109
      DELZB(I)=(ZD(IN)-ZD(I))                                               HYDRO     110
110   DEN1=DELZA(I)*(DELZA(I)+DELZB(I))*DELZB(I)                            HYDRO     111
      QLZ(I)=-((DELZB(I)*DELZB(I))/DEN1)                                    HYDRO     112
      QMZ(I)=((DELZB(I)*DELZB(I))-(DELZA(I)*DELZA(I)))/DEN1                 HYDRO     113
      710 QRZ(I)=(DELZA(I)*DELZA(I))/DEN1                                   HYDRO     114
      165 CONTINUE                                                          HYDRO     115
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      DEN2=DELZA(M1)*(DELZA(M1)+DELZB(M1))*DELZB(M1)                    HYDRO  116
      RLZ=(DELZB(M1)*DELZB(M1))/DEN2                                    HYDRO  117
      RMZ=-(((DELZA(M1)+DELZB(M1))**2)/DEN2)                            HYDRO  118
      RRZ=(DELZA(M1)*(DELZA(M1)+(2.*DELZB(M1))))/DEN2                   HYDRO  119
      DEN4=DELZA(2)*(DELZA(2)+DELZB(2))*DELZB(2)                        HYDRO  120
      PLZ=-(((2.*DELZA(2))+DELZB(2))*DELZB(2))/DEN4                     HYDRO  121
      PMZ=((DELZA(2)+DELZB(2))**2)/DEN4                                 HYDRO  122
      PRZ=-((DELZA(2)*DELZA(2))/DEN4)                                   HYDRO  123
      IF (2.GT.N1)GO TO 175                                             HYDRO  124
      DO 760 J=2,N1                                                     HYDRO  125
      IF (J-KNOT)730,720,730                                            HYDRO  126
  720 DELXA(J)=ABS((RS*6.28318)-(RS*BETA(J-1)))                         HYDRO  127
      GO TO 740                                                         HYDRO  128
  730 DELXA(J)=ABS((RS*BETA(J))-(RS*BETA(J-1)))                         HYDRO  129
  740 IF (J-KNOT)760,750,760                                            HYDRO  130
  750 DELXB(KNOT-1)=ABS((RS*6.28318)-(RS*BETA(KNOT-1)))                 HYDRO  131
  760 DELXB(J)=ABS((RS*BETA(J+1))-(RS*BETA(J)))                         HYDRO  132
  175 CONTINUE                                                          HYDRO  133
      IF (KNOT-2)780,770,780                                            HYDRO  134
  770 DELXB(N1)=ABS((RS*6.28318)-(RS*BETA(N1)))                         HYDRO  135
  780 DELXA(1)=DELXA(N1)                                                HYDRO  136
      DELXA(N2)=DELXA(2)                                                HYDRO  137
      DELXB(1)=DELXB(N1)                                                HYDRO  138
      DELXB(N2)=DELXB(2)                                                HYDRO  139
      IF (2.GT.N)GO TO 185                                              HYDRO  140
      DO 790 J=2,M1                                                     HYDRO  141
      DEN3=DELXA(J)*(DELXA(J)+DELXB(J))*DELXB(J)                        HYDRO  142
      QLX(J)=-((DELXB(J)*DELXB(J))/DEN3)                                HYDRO  143
      QMX(J)=((DELXB(J)*DELXB(J))-(DELXA(J)*DELXA(J)))/DEN3             HYDRO  144
  790 QRX(J)=(DELXA(J)*DELXA(J))/DEN3                                   HYDRO  145
  185 CONTINUE                                                          HYDRO  146
      QLX(1)=QLX(N1)                                                    HYDRO  147
      QLX(N2)=QLX(2)                                                    HYDRO  148
      QMX(1)=QMX(N1)                                                    HYDRO  149
      QMX(N2)=QMX(2)                                                    HYDRO  150
      QRX(1)=QRX(N1)                                                    HYDRO  151
      QRX(N2)=QRX(2)                                                    HYDRO  152
      WRITE (61,2260)                                                   HYDRO  153
      IF (NSB-360)800,810,800                                           HYDRO  154
  800 DEN2=DELXA(N)*(DELXA(N)+DELXB(N))*DELXB(N)                        HYDRO  155
      RLX=(DELXB(N)*DELXB(N))/DEN2                                      HYDRO  156
      RMX=-(((DELXA(N)+DELXB(N))**2))/DEN2                              HYDRO  157
      RRX=(DELXA(N)*(DELXA(N)+(2.*DELXB(N))))/DEN2                      HYDRO  158
      DEN4=DELXA(3)*(DELXA(3)+DELXB(3))*DELXB(3)                        HYDRO  159
      PLX=-(((2.*DELXA(3))+DELXB(3))*DELXB(3))/DEN4                     HYDRO  160
      PMX=((DELXA(3)+DELXB(3))**2)/DEN4                                 HYDRO  161
      PRX=-(DELXA(3)*DELXA(3))/DEN4                                     HYDRO  162
      DELXA(2)=0.                                                       HYDRO  163
      DELXB(N1)=0.                                                      HYDRO  164
  810 ICKCGT=INPP                                                       HYDRO  165
      IF (ICKCGT.LE.1)GO TO 820                                         HYDRO  166
      IF (ICKCGT.GE.2)GO TO 840                                         HYDRO  167
      GO TO (820,840),ICKCGT                                            HYDRO  168
  820 IF (1.GT.M)GO TO 195                                              HYDRO  169
      DO 830 I=1,M                                                      HYDRO  170
      WRITE (61,2270)I                                                  HYDRO  171
      WRITE (61,2280)                                                   HYDRO  172
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      WRITE (61,2290)(J,C(I,J+1),H(I,J+1),U(I,J+1),P(I,J+1),IP(I,J+1),J= HYDRO  173
     +1,N)                                                               HYDRO  174
  830 CONTINUE                                                           HYDRO  175
  195 CONTINUE                                                           HYDRO  176
      WRITE (61,2260)                                                    HYDRO  177
C     SOLUTION OF FINITE DIFFERENCE EQUATIONS FOR PRESSURES              HYDRO  178
  840 ITEMP=0                                                            HYDRO  179
      PPP=0.                                                             HYDRO  180
      IEXIC=0                                                            HYDRO  181
      IF (1.GT.M)GO TO 205                                               HYDRO  182
C ****************  NOTE DO NEST--OUTER MOST DO CHECKED ONLY  *********  HYDRO  183
      DO 850 I=1,M                                                       HYDRO  184
      DO 850 J=1,N1                                                      HYDRO  185
  850 PP(I,J)=P(I,J)                                                     HYDRO  186
  205 CONTINUE                                                           HYDRO  187
  860 SERUP=0.                                                           HYDRO  188
      RPADP=0.                                                           HYDRO  189
      HERR=0.                                                            HYDRO  190
      IF (1.GT.M)GO TO 225                                               HYDRO  191
      DO 870 I=1,M                                                       HYDRO  192
      P(I,1)=P(I,M1)                                                     HYDRO  193
  870 P(I,M2)=P(I,2)                                                     HYDRO  194
  225 CONTINUE                                                           HYDRO  195
      IF (1.GT.M1)GO TO 235                                              HYDRO  196
      DO 1300 I=1,M1                                                     HYDRO  197
      IF (2.GT.N1)GO TO 245                                              HYDRO  198
      DO 1300 J=2,N1                                                     HYDRO  199
      IF (IHC-3)900,880,900                                              HYDRO  200
  880 IF (I-1)900,890,900                                                HYDRO  201
  890 IN=I+1                                                             HYDRO  202
      IM=I+1                                                             HYDRO  203
      JN=J+1                                                             HYDRO  204
      JM=J-1                                                             HYDRO  205
      DELX1=DELXA(J)                                                     HYDRO  206
      DELX2=DELXB(J)                                                     HYDRO  207
      DELX3=(DELX1+DELX2)/2.                                             HYDRO  208
      DELZ1=DELZA(2)                                                     HYDRO  209
      DELZ2=DELZA(2)                                                     HYDRO  210
      DELZ3=DELZA(2)                                                     HYDRO  211
      IF (IP(I,J)-1)920,1300,920                                         HYDRO  212
  900 IF (IP(I,J)-1)910,1300,910                                         HYDRO  213
C     INTERIOR POINTS GO TO 105 BOUNDARY POINTS TO 125                   HYDRO  214
  910 IN=I+1                                                             HYDRO  215
      IM=I-1                                                             HYDRO  216
      JN=J+1                                                             HYDRO  217
      JM=J-1                                                             HYDRO  218
      DELX1=DELXA(J)                                                     HYDRO  219
      DELX2=DELXB(J)                                                     HYDRO  220
      DELX3=(DELX1+DELX2)/2.                                             HYDRO  221
      DELZ1=DELZA(1)                                                     HYDRO  222
      DELZ2=DELZB(1)                                                     HYDRO  223
      DELZ3=(DELZ1+DELZ2)/2.                                             HYDRO  224
  920 PAPZ=(QLZ(I)*P(IM,J))+(QMZ(I)*P(I,J))+(QRZ(I)*P(IN,J))             HYDRO  225
      PAPX=(QLX(J)*P(I,JM))+(QMX(J)*P(I,J))+(QRX(J)*P(I,JN))             HYDRO  226
      TERMA=(((CHOU(I,JM)/XK(I,JM))+(CHOU(I,J)/XK(I,J)))/2.)*P(I,JN)     HYDRO  227
      TERMB=(((CHOU(I,JM)/XK(I,JM))+(CHOU(I,J)/XK(I,J)))/2.)*P(I,JM)     HYDRO  228
      TERM1=((TERMA/DELX2)+(TERMB/DELX1))/DELX3                          HYDRO  229
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                TERMC=(((CHOU(IN,J)/ZK(IN,J))+(CHOU(I,J)/ZK(I,J)))/2.)*P(IN,J)                HYDRO  230
230             TERMU=(((CHOU(IM,J)/ZK(IM,J))+(CHOU(I,J)/ZK(I,J)))/2.)*P(IM,J)                HYDRO  231
                TERM2=((TERMC/DELZ2)+(TERMU/DELZ1))/DELZ3                                     HYDRO  232
                CHJ=((((CHOU(I,JN)/XK(I,JN))+(CHOU(I,J)/XK(I,J)))/2.)/DELX2)+((((C            HYDRO  233
               +HOU(I,JM)/XK(I,JM))+(CHOU(I,J)/XK(I,J)))/2.)/DELX1)                           HYDRO  234
                CHI=((((CHOU(IN,J)/ZK(IN,J))+(CHOU(I,J)/ZK(I,J)))/2.)/DELZ2)+((((C            HYDRO  235
230             +HOU(IM,J)/ZK(IM,J))+(CHOU(I,J)/ZK(I,J)))/2.)/DELZ1)                          HYDRO  236
                GBF=TERM1                                                                     HYDRO  237
                GBI=TERM2                                                                     HYDRO  238
                GBE=-(CHJ/DELX3)                                                              HYDRO  239
                GBM=-(CHI/DELZ3)                                                              HYDRO  240
240             CHOKE=0.                                                                      HYDRO  241
                SGHM=0.                                                                       HYDRO  242
              C PRECESS PRESSURE ARRAYS                                                       HYDRO  243
                OOP(I,J)=OP(I,J)                                                              HYDRO  244
                OP(I,J)=P(I,J)                                                                HYDRO  245
250             ICKCGT=IMCF                                                                   HYDRO  246
                IF (ICKCGT.LE.1)GO TO 930                                                     HYDRO  247
                IF (ICKCGT.GE.2)GO TO 970                                                     HYDRO  248
                GO TO (930,970),ICKCGT                                                        HYDRO  249
              930 ICKCGT=IRPO                                                                 HYDRO  250
260             IF (ICKCGT.LE.1)GO TO 940                                                     HYDRO  251
                IF (ICKCGT.GE.3)GO TO 950                                                     HYDRO  252
                GO TO (940,950,950),ICKCGT                                                    HYDRO  253
              940 SGHM=(-6.)*((2.*VARA)/(VARDY*U(I,J)))                                       HYDRO  254
                GO TO 960                                                                     HYDRO  255
270           950 IF (IP(I,J)-2)960,940,960                                                   HYDRO  256
              960 SGHM=SRR(I,J)+(VARPS*SGBM)                                                  HYDRO  257
                OLDP=P(I,J)                                                                   HYDRO  258
                PP(I,J)=-((GBF*GBI-SGBF)/(GBE*GBM+SGBM))                                      HYDRO  259
                GO TO 1140                                                                    HYDRO  260
280           970 ICKCGT=IRPO                                                                 HYDRO  261
                IF (ICKCGT.LE.1)GO TO 980                                                     HYDRO  262
                IF (ICKCGT.GE.3)GO TO 1120                                                    HYDRO  263
                GO TO (980,1120,1120),ICKCGT                                                  HYDRO  264
              980 IF (IP(I,J)-2)990,1090,990                                                  HYDRO  265
290           990 SGHM=(-6.)*((2.*VARA)/(VARDY*U(I,J)))                                       HYDRO  266
             1000 SGHK=SRR(I,J)+(VARPS*SGBM)                                                  HYDRO  267
             1010 OLDP=P(I,J)                                                                 HYDRO  268
                IF (IMC-3)1040,1020,1040                                                      HYDRO  269
             1020 IF (I-1)1040,1030,1040                                                      HYDRO  270
300          1030 PAPZ=0.                                                                     HYDRO  271
             1040 GBF=(CHOU(I,J)/XK(I,J))*(PAPX**2)                                           HYDRO  272
                GBJ=(CHOU(I,J)/ZK(I,J))*((PAPZ)**2)                                           HYDRO  273
                TEMP=(EDDY(I)*(SIN(BETA(J)-ALPHA(I))))-(E(I)*ALPHU(I)*(COS(BETA(J)            HYDRO  274
               +-ALPHA(I))))                                                                  HYDRO  275
310             GBL=(U(I,J)*((W-C(I,J))*S)-(2.*R*PV)+(C(I,J)*PV)+TEMP)*PAPX                   HYDRO  276
                CTERM=4.*(GBF+GBM+SGBM)*(GBG+GBJ-(6.*GBL)+(6.*CHOKE))                         HYDRO  277
                RAD=((GBF+GBI-SGBK)**2)-CTERM                                                 HYDRO  278
                IF (RAD)1050,1060,1060                                                        HYDRO  279
             1050 RAD=0.                                                                      HYDRO  280
320          1060 PP(I,J)=((-1.)*((GBF+GBI-SGBK)-SQRT(RAD)))/(2.*(GBE+GBM+SGBM))              HYDRO  281
                IF (IP(I,J)-3)1140,1070,1140                                                  HYDRO  282
             1070 IF (PP(I,J)-PS)1140,1080,1080                                               HYDRO  283
             1080 PP(I,J)=PS                                                                  HYDRO  284
                GO TO 1140                                                                    HYDRO  285
330          1090 IF (IP(I,J)/PS)-((2./(SHK+1.))**(SHK/(SHK-1.)))1100,1110,1110               HYDRO  286
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                1100 SQHK=SHR(I,J)                                                      HYDRO    287
                     HRA=2.*386.04*386.04*PS*RHO*(SHR/(SHR+1.))*((2./(SHR+1.))**(2./(SH HYDRO    288
                    +R-1.)))                                                            HYDRO    289
                     CHOKE=((24.*A0*CV*HGAS*TGAS)/(DELX3*DELZ3))*SQRT(HRA)              HYDRO    290
      240            GO TO 1010                                                         HYDRO    291
                1110 HM1=SQRT(2.*(SHR/(SHR-1.))*(PS/RHO))                               HYDRO    292
                     HM2=SQRT(ABS(1.-(P(I,J)/PS)**((SHR-1.)/SHR)))                      HYDRO    293
                     HM3=((2.*A0*CV)/(DELX3*DELZ3))*HM1*HM2                             HYDRO    294
                     SQHK=SHR(I,J)*(6.*HM3*((P(I,J)-PS)/(ABS(P(I,J)-PS))))              HYDRO    295
      245            GO TO 1010                                                         HYDRO    296
                1120 IF (IP(I,J))1130,1000,1130                                         HYDRO    297
                1130 IF (IP(I,J)-2)1300,990,1090                                        HYDRO    298
                1140 IF (FILMP-PP(I,J))1100,1280,1150                                   HYDRO    299
                1150 PP(I,J)=FILMP                                                      HYDRO    300
      300            GO TO 1280                                                         HYDRO    301
                1160 IF (PP(I,J)-1.-FILMP)1280,1170,1170                                HYDRO    302
                1170 DIFFP=ABS(PP(I,J)-OLDP)                                            HYDRO    303
                     PADP=ABS(DIFFP/(PP(I,J)-PARM))                                     HYDRO    304
                     IF (SPADP-PADP)1180,1190,1190                                      HYDRO    305
      305       1180 II=I                                                              HYDRO    306
                     JJ=J                                                               HYDRO    307
                     HPADP=PADP                                                         HYDRO    308
                1190 IF (PADP-.00001)1280,1280,1200                                     HYDRO    309
                1200 IF (OOP(I,J)-FILMP-1.)1280,1280,1210                               HYDRO    310
      310       1210 IF (OOP(I,J)-FILMP-1.)1280,1280,1220                               HYDRO    311
                1220 IF (PP(I,J)-FILMP-1.)1280,1280,1230                                HYDRO    312
                1230 IF (OOP(I,J)-100000.)1240,1250,1250                                HYDRO    313
                1240 PEXT=0.25*(((2.*OP(I,J))*PP(I,J)+OOP(I,J))*(((PP(I,J)-OOP(I,J))**2 HYDRO    314
                    +)/((2.*OP(I,J))-PP(I,J)-OOP(I,J))))                                HYDRO    315
      315           ERR=ABS((PEXT-PP(I,J))/PP(I,J))                                    HYDRO    316
                     IF (ERR-(.5*ERRUP))1250,1250,1260                                  HYDRO    317
                1250 OP(I,J)=1000000.                                                   HYDRO    318
                     GO TO 1280                                                         HYDRO    319
                1260 IF (HERR-ERR)1270,1280,1280                                        HYDRO    320
      320       1270 HERR=ERR                                                          HYDRO    321
                     III=I                                                              HYDRO    322
                     JJJ=J                                                              HYDRO    323
                1280 IF (ABS(RELAX-1.)-.001)1300,1300,1290                              HYDRO    324
                1290 ADIFF=PP(I,J)-OLDP                                                 HYDRO    325
      325            PP(I,J)=(ADIFF*RELAX)+OLDP                                        HYDRO    326
                1300 CONTINUE                                                           HYDRO    327
                 245 CONTINUE                                                           HYDRO    328
                 235 CONTINUE                                                           HYDRO    329
                     ITEMP=ITEMP+1                                                      HYDRO    330
      330            IF (I.GT.M)GO TO 255                                              HYDRO    331
                C ********************  NOTE DO NEST--OUTER MOST DO CHECKED ONLY  ********** HYDRO    332
                     DO 1310 I=1,M                                                      HYDRO    333
                     DO 1310 J=1,N1                                                     HYDRO    334
                1310 P(I,J)=PP(I,J)                                                     HYDRO    335
      335            255 CONTINUE                                                      HYDRO    336
                     IEXTC=IEXTC+1                                                      HYDRO    337
                     IF (IEXTC-IEXT)960,1320,1320                                       HYDRO    338
                1320 IF (SPADP-ERRUP)1330,1330,1340                                     HYDRO    339
                1330 IF (HERR-ERRDP)1350,1350,1340                                      HYDRO    340
      340       1340 IF (ITEMP-LP)960,1350,1350                                        HYDRO    341
                1350 XPRESS=2                                                           HYDRO    342
                1360 IF (I.GT.M)GO TO 275                                               HYDRO    343
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                DO 1370 I=1,M                                                    HYDRO    344
                P(I,1)=P(I,N1)                                                   HYDRO    345
345        1370 P(I,N2)=P(I,2)                                                   HYDRO    346
            275 CONTINUE                                                         HYDRO    347
                SFX=0.                                                           HYDRO    348
                SFXB=0.                                                          HYDRO    349
                SFY=0.                                                           HYDRO    350
350             SFYB=0.                                                          HYDRO    351
                SMX=0.                                                           HYDRO    352
                SMXB=0.                                                          HYDRO    353
                SMY=0.                                                           HYDRO    354
                SMYB=0.                                                          HYDRO    355
355             IF (I.GT.M)GO TO 285                                             HYDRO    356
              C ****************  NOTE DO NEST--OUTER MOST DO CHECKED ONLY  ********* HYDRO  357
                DO 1380 I=1,M                                                    HYDRO    358
                DO 1380 J=1,N2                                                   HYDRO    359
            1380 P(I,J)=P(I,J)-PBR1                                              HYDRO    360
360          285 CONTINUE                                                        HYDRO    361
                IF (2.GT.N1)GO TO 305                                            HYDRO    362
              C ****************  NOTE DO NEST--OUTER MOST DO CHECKED ONLY  ********* HYDRO  363
                DO 1390 I=2,M1                                                   HYDRO    364
                DO 1390 J=2,N1                                                   HYDRO    365
365             DELXZ=((DELXA(J)+DELXB(J))*(DELZA(I)+DELZB(I)))/4.               HYDRO    366
                KEND=MOD(J-1,NODFL2)                                             HYDRO    367
                IF(KEND.EQ.0)DELXZ=DELYA(J)*(DELZA(I)+DELZB(I))/4.               HYDRO    368
                IF(KEND.EQ.1)DELXZ=DELYB(J)*(DELZA(I)+DELZB(I))/4.               HYDRO    369
                XFX=P(I,J)*COS(BETA(J))                                          HYDRO    370
370             XFY=P(I,J)*SIN(BETA(J))                                          HYDRO    371
                IF(KEND.EQ.0)XFX=(P(I,J)+(P(I,J)+P(I,J-1))/2.)/2.*COS(BETA(J))   HYDRO    372
                IF(KEND.EQ.0)XFY=(P(I,J)+(P(I,J)+P(I,J-1))/2.)/2.*SIN(BETA(J))   HYDRO    373
                IF(KEND.EQ.1)XFX=(P(I,J)+(P(I,J)+P(I,J+1))/2.)/2.*COS(BETA(J))   HYDRO    374
                IF(KEND.EQ.1)XFY=(P(I,J)+(P(I,J)+P(I,J+1))/2.)/2.*SIN(BETA(J))   HYDRO    375
375             SFX=XFX*DELXZ+SFX                                                HYDRO    376
                SFY=XFY*DELXZ+SFY                                                HYDRO    377
                SMX=ZD(I)*XFY*DELXZ+SMX                                          HYDRO    378
            1390 SMY=ZD(I)*XFX*DELXZ+SMY                                         HYDRO    379
             305 CONTINUE                                                        HYDRO    380
380             IF (2.GT.N1)GO TO 325                                            HYDRO    381
                DO 1400 J=2,N1                                                   HYDRO    382
                DELXZ=((DELXA(J)+DELXB(J))*DELZA(2))/4.                          HYDRO    383
                DEMXZ=((DELXA(J)+DELXB(J))*DELZB(M1))/4.                         HYDRO    384
                KEND=MOD(J-1,NODFL2)                                             HYDRO    385
385             IF(KEND.EQ.0)DEIXZ=DELYA(J)*DELZA(2)/4.                          HYDRO    386
                IF(KEND.EQ.0)DEMXZ=DELYA(J)*DELZB(M1)/4.                         HYDRO    387
                IF(KEND.EQ.1)DEIXZ=DELYB(J)*DELZA(2)/4.                          HYDRO    388
                IF(KEND.EQ.1)DEMXZ=DELYB(J)*DELZB(M1)/4.                         HYDRO    389
                SFXB=(((P(1,J)*COS(BETA(J)))*DEIXZ)+((P(M,J)*COS(BETA(J)))*DEMXZ)) HYDRO  390
390             **SFXB                                                           HYDRO    391
                SFYB=(((P(1,J)*SIN(BETA(J)))*DEIXZ)+((P(M,J)*SIN(BETA(J)))*DEMXZ)) HYDRO 392
                **SFYB                                                           HYDRO    393
                SMXB=(((ZD(1)*P(1,J)*SIN(BETA(J)))*DEIXZ)+((ZD(M)*P(M,J)*SIN(BETA( HYDRO  394
                +J)))*DEMXZ))+SMXB                                               HYDRO    395
395         1400 SMYB=(((ZD(1)*P(1,J)*COS(BETA(J)))*DEIXZ)+((ZD(M)*P(M,J)*COS(BETA( HYDRO  396
                +J)))*DEIXZ))+SMYB                                               HYDRO    397
             325 CONTINUE                                                        HYDRO    398
                FX=SFX+SFXB                                                      HYDRO    399
                FY=SFY+SFYB                                                      HYDRO    400
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      XM=SMX+SMXH                                                                HYDRO  401
      YM=SMY+SMYH                                                                HYDRO  402
      IF (1.GT.M)GO TO 335                                                       HYDRO  403
C ****************  NOTE DO NEST--OUTER MOST DO CHECKED ONLY  *********          HYDRO  404
      DO 1410 I=1,M                                                              HYDRO  405
      DO 1410 J=1,N2                                                             HYDRO  406
 1410 P(I,J)=P(I,J)*PHR1                                                         HYDRO  407
  335 CONTINUE                                                                   HYDRO  408
      IF (1.GT.M)GO TO 355                                                       HYDRO  409
      DO 1460 I=1,M                                                              HYDRO  410
      IF (2.GT.N1)GO TO 365                                                      HYDRO  411
      DO 1460 J=2,N1                                                             HYDRO  412
      IF (I-1)1430,1420,1430                                                     HYDRO  413
 1420 PAPZ(1,J)=(PLZ*P(I,J))+(PMZ*P(2,J))+(PRZ*P(3,J))                           HYDRO  414
      GO TO 1460                                                                 HYDRO  415
 1430 IF (I-M)1450,1440,1450                                                     HYDRO  416
 1440 PAPZ(I,J)=(PLZ*P(M-2,J))+(RMZ*P(M-1,J))+(RRZ*P(M,J))                       HYDRO  417
      GO TO 1460                                                                 HYDRO  418
 1450 PAPZ(I,J)=(QLZ(I)*P(I-1,J))+(QMZ(I)*P(I,J))+(QRZ(I)*P(I+1,J))              HYDRO  419
 1460 CONTINUE                                                                   HYDRO  420
  365 CONTINUE                                                                   HYDRO  421
  355 CONTINUE                                                                   HYDRO  422
      I=ID1                                                                      HYDRO  423
      IID=1                                                                      HYDRO  424
      GO TO 1500                                                                 HYDRO  425
 1470 Q1=QS                                                                      HYDRO  426
      I=ID2                                                                      HYDRO  427
      IID=2                                                                      HYDRO  428
      GO TO 1500                                                                 HYDRO  429
 1480 Q2=QS                                                                      HYDRO  430
      I=ID3                                                                      HYDRO  431
      IID=3                                                                      HYDRO  432
      GO TO 1500                                                                 HYDRO  433
 1490 Q3=QS                                                                      HYDRO  434
      GO TO 183                                                                  HYDRO  435
 1500 QS=0.                                                                      HYDRO  436
      IF (2.GT.N1)GO TO 375                                                      HYDRO  437
      DO 9000 J=2,N1                                                             HYDRO  438
      IF(CHOU(I,J).EQ.0) GO TO 9000                                              HYDRO  439
 1510 QS=(((DELXA(J)+DELXB(J))/2.)*((-PAPZ(I,J))*(CHOU(I,J)/ZK(I,J)))/12        HYDRO  440
     *.)+QS                                                                      HYDRO  441
 9000 CONTINUE                                                                   HYDRO  442
  375 CONTINUE                                                                   HYDRO  443
      IF(IID.LE.1)GO TO 1470                                                     HYDRO  444
      IF(IID.GE.3)GO TO 1490                                                     HYDRO  445
      GO TO (1470,1480,1490)IID                                                  HYDRO  446
  183 IF(NSB-360)787,788,787                                                     HYDRO  447
  787 IF(I.GT.M.OR.2.GT.N1)GO TO 9310                                            HYDRO  448
      DO 931 I=1,M                                                               HYDRO  449
      DO 931 J=2,N1                                                              HYDRO  450
      IF(J-2)927,928,927                                                         HYDRO  451
  928 PAPL(I,J)=(PLX*P(I,2))+(PMX*P(I,3))+(PRX*P(I,4))                           HYDRO  452
      GO TO 931                                                                  HYDRO  453
  927 IF(J-N1)929,9300,929                                                       HYDRO  454
 9300 PAPL(I,J)=(PLX*P(I,N-1))+(PMX*P(I,N))+(PRX*P(I,N+1))                       HYDRO  455
      GO TO 931                                                                  HYDRO  456
  929 PAPL(I,J)=(QLX(J)*P(I,J-1))+(QMX(J)*P(I,J))+(QRX(J)*P(I,J+1))              HYDRO  457
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                  931 CONTINUE                                                          HYDRO   458
                 9310 CONTINUE                                                          HYDRO   459
                      GO TO 932                                                         HYDRO   460
      460          788 IF(I.GT.M.OR.2.GT.N1)GO TO 932                                  HYDRO   461
                      DO 933 I=1,M                                                      HYDRO   462
                      DO 933 J=2,N1                                                     HYDRO   463
                  933 PAPL(I,J)=(QLX(J)*P(I,J-1))+(QMX(J)*P(I,J))+(QRX(J)*P(I,J+1))     HYDRO   464
                  932 IF(I.GT.M.OR.2.GT.N1)GO TO 2041                                   HYDRO   465
      465             DO 204 I=1,M                                                      HYDRO   466
                      DO 204 J=2,N1                                                     HYDRO   467
                      WBAR(I,J)=(-1./(12.*U(I,J)*ZK(I,J)))*PAPZ(I,J)*(H(I,J)**2)        HYDRO   468
                      TE1=(-1./(12.*U(I,J)*XK(I,J)))*PAPL(I,J)*(H(I,J)**2)              HYDRO   469
                      U1=(EDOT(I)*SIN(BETA(J)-ALPHA(I)))-((E(I)*COS(BETA(J)-ALPHA(I)))  HYDRO   470
      470           1 *ALPHD(I))-(R*PV)                                                 HYDRO   471
                  204 UBAR(I,J)=TE1+((((R-C(I,J))*(S-PV))+U1)/2.)                       HYDRO   472
                 2041 CONTINUE                                                          HYDRO   473
                      SMF1=0.                                                           HYDRO   474
                      SMF2=0.                                                           HYDRO   475
      475             VSTAR=0.05*DIFU(1,2)                                              HYDRO   476
                      GO TO 1680                                                        HYDRO   477
                  753 STAN=ALOG(TF1*STARO)-(TF2/STARO)+1.                               HYDRO   478
                      STAD=TF1+(EXP((TF2/STARO)-1.)*(TF2/(STARO*STARO)))                HYDRO   479
                      VSTAR=STARO-(STAN/STAD)                                           HYDRO   480
      480             DIFST=ABS(VSTAR-STARO)                                            HYDRO   481
                      IF((DIFST/VSTAR)-0.01)754,754,755                                 HYDRO   482
                  755 KNT=KNT+1                                                         HYDRO   483
                      IF(KNT-50)756,757,757                                             HYDRO   484
                  756 STARO=VSTAR                                                       HYDRO   485
      485             GO TO 753                                                         HYDRO   486
                  757 KERIC=2                                                           HYDRO   487
                      FMH=0.                                                            HYDRO   488
                      FMJ=0.                                                            HYDRO   489
                      GO TO 1780                                                        HYDRO   490
      490         754 TAUA=RHO*(VSTAR*VSTAR)                                            HYDRO   491
                      GO TO 1710                                                        HYDRO   492
                 1680 IF (I.GT.M)GO TO 445                                              HYDRO   493
                      DO 1770 I=1,M                                                     HYDRO   494
                      IF (2.GT.N1)GO TO 455                                             HYDRO   495
      495             DO 1770 J=2,N1                                                    HYDRO   496
                      PAPX=(QLX(J)*P(I,J-1))+(QMX(J)*P(I,J))+(QRX(J)*P(I,J+1))          HYDRO   497
                      IF (CODE(I,J)-1.)1700,1690,1700                                   HYDRO   498
                 1690 TAUA=0.                                                           HYDRO   499
                      IF(DIFU(I,J).NE.0.)TAUA=U(I,J)*(DIFU(I,J)/H(I,J))                 HYDRO   500
      500             GO TO 1710                                                        HYDRO   501
                 1700 TF1=(CONK*H(I,J))/(2.*(U(I,J)/RHO))                               HYDRO   502
                      TF2=0.                                                            HYDRO   503
                      IF(DIFU(I,J).NE.0.)TF2=CONK*(DIFU(I,J)/2.)                        HYDRO   504
                      KNT=0                                                             HYDRO   505
      505             GO TO 756                                                         HYDRO   506
                 1710 TAUH=(H(I,J)*PAPL(I,J))*0.5                                       HYDRO   507
                      IF (I-1)1740,1720,1740                                            HYDRO   508
                 1720 DZDAC=((DELXA(J)+DELXB(J))*DELZA(2))/4.                           HYDRO   509
                 1730 SMF1=(DZDAC*TAUA)+SMF1                                            HYDRO   510
      510             SMF2=(DZDAC*TAUB)+SMF2                                            HYDRO   511
                      GO TO 1770                                                        HYDRO   512
                 1740 IF (I-M)1760,1750,1760                                            HYDRO   513
                 1750 DZDAC=((DELXA(J)+DELXB(J))*DELZB(M1))/4.                          HYDRO   514
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      GO TO 1730                                                        HYDRO  515
1760  DZDXC=((DELXA(J)+DELXB(J))*(DELZA(I)+DELZB(I)))/4.                HYDRO  516
      GO TO 1730                                                        HYDRO  517
1770  CONTINUE                                                          HYDRO  518
 455  CONTINUE                                                          HYDRO  519
 445  CONTINUE                                                          HYDRO  520
      FMB=RS*(SMF1-SMF2)                                                HYDRO  521
      FMJ=RS*(SMF1+SMF2)                                                HYDRO  522
1780  ANG=ATAN(FY/FX)                                                   HYDRO  523
      IF (FX)1790,1800,1800                                             HYDRO  524
1790  ANG=ANG+3.1416                                                    HYDRO  525
1800  ATTA=((180./3.1416)*ANG)-ALPH1                                    HYDRO  526
      RESTF=SQRT((FX*FX)+(FY*FY))                                       HYDRO  527
      FHP=(FMJ*S)/6600.                                                 HYDRO  528
      FW=(2545./3.413)*FHP                                              HYDRO  529
      WRITE (61,1990)                                                   HYDRO  530
      WRITE (61,2000)                                                   HYDRO  531
      WRITE (61,2300)                                                   HYDRO  532
      ICKCGT=KPRESS                                                     HYDRO  533
      IF (ICKCGT.LE.1)GO TO 1820                                        HYDRO  534
      IF (ICKCGT.GE.2)GO TO 1810                                        HYDRO  535
      GO TO (1820,1810),ICKCGT                                          HYDRO  536
1810  BPADP=100.*BPADP                                                  HYDRO  537
      BERR=100.*BERR                                                    HYDRO  538
      WRITE (61,2310)II,JJ,BPADP,III,JJJ,BERR                           HYDRO  539
1820  ICKCGT=KFRIC                                                      HYDRO  540
      IF (ICKCGT.LE.1)GO TO 1840                                        HYDRO  541
      IF (ICKCGT.GE.2)GO TO 1830                                        HYDRO  542
      GO TO (1840,1830),ICKCGT                                          HYDRO  543
1830  WRITE (61,2320)                                                   HYDRO  544
1840  WRITE (61,2330)                                                   HYDRO  545
      IF (IPC-3)1860,1850,1860                                          HYDRO  546
1850  RESTF=2.*RESTF                                                    HYDRO  547
      FMJ=2.*FMJ                                                        HYDRO  548
      FMB=2.*FMB                                                        HYDRO  549
      FHP=2.*FHP                                                        HYDRO  550
      FW=2.*FW                                                          HYDRO  551
      FX=2.*FX                                                          HYDRO  552
      FY=2.*FY                                                          HYDRO  553
      WRITE (61,2340)                                                   HYDRO  554
1860  WRITE (61,2350)                                                   HYDRO  555
      WRITE (61,2360)                                                   HYDRO  556
      WRITE (61,2370)EC,RESTF,ATTA,FMJ,FMB                              HYDRO  557
      WRITE (61,2380)                                                   HYDRO  558
      WRITE (61,2390)                                                   HYDRO  559
      WRITE (61,2400)FHP,FW,Q1,Q2,Q3                                    HYDRO  560
      WRITE (61,2410)                                                   HYDRO  561
      WRITE (61,2420)                                                   HYDRO  562
      IF (IPC-3)1870,1880,1870                                          HYDRO  563
1870  WRITE (61,2430)FX,FY,XM,YM                                        HYDRO  564
      GO TO 1890                                                        HYDRO  565
1880  WRITE (61,2430)FX,FY                                              HYDRO  566
1890  WRITE (61,2330)                                                   HYDRO  567
      IF (ERRA)1970,1970,1900                                           HYDRO  568
1900  WRITE (61,2010)                                                   HYDRO  569
      INPP=2                                                            HYDRO  570
      IF (ABS(ATTA,ALPH1)-ERRA)1960,1960,1910                           HYDRO  571
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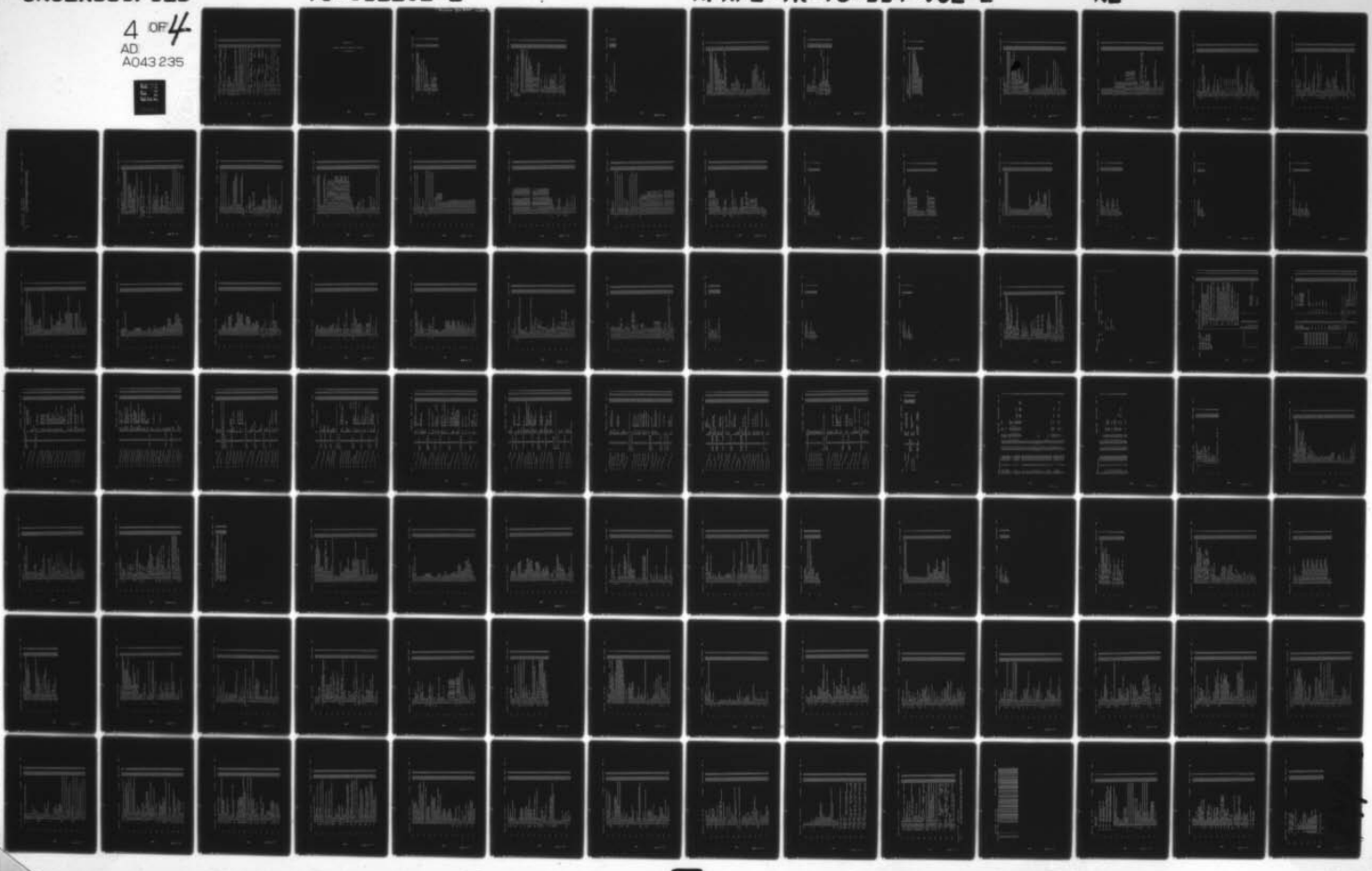
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      1910 IF (ATTA+ALPH1)1920,1930,1930                                    HYDRO    572
      1920 ALPH1=-ATTA                                                      HYDRO    573
           GO TO 1940                                                       HYDRO    574
      1930 ALPH1=-ATTA                                                      HYDRO    575
575   1940 IF (1.GT.M)GO TO 465                                             HYDRO    576
           DO 1950 I=1,M                                                    HYDRO    577
      1950 ALPHA(I)=(ALPH1*3.1416)/180.                                     HYDRO    578
       465 CONTINUE                                                         HYDRO    579
           GO TO 610                                                        HYDRO    580
580   1960 SOM=((RS**3)*(U9/(C9*C9))*S*(AXLEN/RESTF))/3.1416                HYDRO    581
           RES=(RS/U9)*S*RHO*C9                                             HYDRO    582
           REK=CONK*CONK*RES                                                HYDRO    583
           XKS=12.+(.53*(REK**.725))                                        HYDRO    584
           ZKS=12.+(.296*(REK**.65))                                        HYDRO    585
585        T6=1./(XKS*SOM)                                                  HYDRO    586
           T7=(AXLEN/(2.*RS))*SQRT(ZKS/XKS)                                 HYDRO    587
           WRITE (61,2330)                                                  HYDRO    588
           WRITE (61,2440)RES,SOM,CONK,XKS,ZKS                              HYDRO    589
           WRITE (61,2450)T6,T7,ALPH1                                       HYDRO    590
590        WRITE (61,2330)                                                  HYDRO    591
           WRITE (61,2010)                                                  HYDRO    592
      1970 IF (1.GT.M)GO TO 475                                             HYDRO    593
           DO 1980 I=1,M                                                    HYDRO    594
           WRITE (61,2420)I                                                 HYDRO    595
595        WRITE (61,2460)                                                  HYDRO    596
      1980 WRITE (61,2470)(J,P(I,J+1),UBAR(I,J+1),WBAR(I,J+1),RE(I,J+1),CODE( HYDRO    597
          +I,J+1),J=1,N)                                                    HYDRO    598
       475 CONTINUE                                                         HYDRO    599
           WRITE (61,2490)                                                  HYDRO    600
600        C                                                                HYDRO    601
      1990 FORMAT (43H HYDRODYNAMIC GAS OR LIQUID BEARING PROGRAM,///)      HYDRO    602
      2000 FORMAT (1X,71H                                                   HYDRO    603
          +                    )                                           HYDRO    604
      2010 FORMAT (1H )                                                     HYDRO    605
605   2020 FORMAT (6E12.3)                                                  HYDRO    606
      2030 FORMAT (5E12.3,2F6.0)                                            HYDRO    607
      2040 FORMAT (18I4)                                                    HYDRO    608
      2050 FORMAT (120H RADIUS BEARING   RADIUS SHAFT        DENSITY      VIS HYDRO    609
          +COSITY  Z-DIST. TO CG   AXIAL LENGTH   PRESS. ROW 1   PRESS. ROW M HYDRO    610
610       +)                                                                HYDRO    611
      2060 FORMAT (8E15.6/)                                                 HYDRO    612
      2070 FORMAT (120H MINIMUM PRESS.  ERROR LIMIT P     SPIN SPEED        HYDRO    613
          + WHIRL     ECC. RATIO   DERIVATIVE E    ANGLE ALPHA   DERIV. ALPHA HYDRO    614
          +)                                                                HYDRO    615
615   2080 FORMAT (120H ROWS COLS. BETA=0 LIM.P SHOE P TO 0 FLOW PRT.M READ C HYDRO    616
          + READ POR READ O READ M READ P READ B READ Z FLOW 1 FLOW 2 FLOW 3 HYDRO    617
          +)                                                                HYDRO    618
      2090 FORMAT (I5,I6,I7,I6,I5,I7,I5,I6,I7,I9,817/)                      HYDRO    619
      2100 FORMAT (46H RELAX(DELTA P)  NO. ITER. BEFORE EXTRAP. TEST)       HYDRO    620
620   2110 FORMAT (E15.6,F31.0///)                                          HYDRO    621
      2120 FORMAT (70H RELAX(DELTA P)  NO. ITER. BEFORE EXTRAP. TEST   ALLOWA HYDRO    622
          +BLE ERROR ALPHA)                                                 HYDRO    623
      2130 FORMAT (E15.6,F31.0,E24.5///)                                    HYDRO    624
      2140 FORMAT (3E12.3)                                                  HYDRO    625
525   2150 FORMAT (60H         PERMEABILITY     SUPPLY PRESSURE  MATERIAL THIC HYDRO    626
          +KNESS)                                                           HYDRO    627
      2160 FORMAT (3E20.6/)                                                 HYDRO    628
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62500

AD-A043 235 AIRESEARCH MFG CO OF ARIZONA PHOENIX F/G 13/9
GAS LUBRICATED FOIL BEARING DEVELOPMENT FOR ADVANCED TURBOMACHI--ETC(U)
APR 77 E S ZORZI F33615-73-C-2058
UNCLASSIFIED 76-312202-2 AFAPL-TR-76-114-VOL-2 NL

4 OF 4
AD
A043 235



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      2170 FORMAT (6E12.6)                                                      HYDRO     629
      2180 FORMAT (120H    ORIFICE DIAMETER    FLOW COEFFICIENT SPECIFIC HEAT  HYDRO     630
     + RATIO     SUPPLY PRESSURE      GAS CONSTANT-R      GAS CONSTANT-T       HYDRO     631
     +)                                                                         HYDRO     632
      2190 FORMAT (6E20.6///)                                                   HYDRO     633
      2200 FORMAT (120H                X SUB 0              Y SUB 0            HYDRO     634
     + THETA  DERIVATIVE X SUB 0  DERIVATIVE Y SUB 0    DERIVATIVE THETA       HYDRO     635
     +)                                                                         HYDRO     636
      2210 FORMAT (6E20.6//)                                                    HYDRO     637
      2220 FORMAT (2I5,3E12.3,I5,I2)                                            HYDRO     638
      2230 FORMAT (2I5,E12.3,I5,I2)                                             HYDRO     639
      2240 FORMAT (10F7.2)                                                      HYDRO     640
      2250 FORMAT (6E12.3)                                                      HYDRO     641
      2260 FORMAT (1H1)                                                         HYDRO     642
      2270 FORMAT (5H0 I =,I2/)                                                 HYDRO     643
      2280 FORMAT (116H  J   CLEARANCE  FILM THICK   VISCOSITY    PRESSURE  C  HYDRO     644
     +ODE    J   CLEARANCE  FILM THICK   VISCOSITY    PRESSURE  CODE)          HYDRO     645
      2290 FORMAT (I3,4E12.5,I6,2X,I3,4E12.5,I6)                                HYDRO     646
      2300 FORMAT (1H0,//)                                                      HYDRO     647
      2310 FORMAT (34H ITERATIONS ARE AT LIMIT--POINT I=,I5,3H J=,I5,27H HAS    HYDRO     648
     +LARGEST PER CENT ERROR =,E12.5/25X,9H POINT I=,I5,3H J=,I5,37H HAS        HYDRO     649
     + LARGEST EXTRAPOLATED AVE. ERROR=,E12.5//)                                HYDRO     650
      2320 FORMAT (59H ITERATION FOR VSTAR AT LIMIT FRICTION CALCULATIONS DEL   HYDRO     651
     +ETED,////)                                                                HYDRO     652
      2330 FORMAT (119H * * * * * * * * * * * * * * * * * * * * * * * * * * *  HYDRO     653
     + * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * ,  HYDRO     654
     +/)                                                                        HYDRO     655
      2340 FORMAT (63H  SYMMETRY ROUTINE USED -- VALUES PRINTED ARE FOR WHOLE   HYDRO     656
     + BEARING,/)                                                               HYDRO     657
      2350 FORMAT (120H       ECCENTRICITY RATIO          RESULTANT FORCE       HYDRO     658
     +    ATTITUDE ANGLE    JOURNAL FRIC. MOMENT    BEARING FRIC. MOMENT       HYDRO     659
     +)                                                                         HYDRO     660
      2360 FORMAT (120H                (---)                    (LBS)         HYDRO     661
     +       (DEGREES)              (IN-LBS)                 (IN-LBS)          HYDRO     662
     +)                                                                         HYDRO     663
      2370 FORMAT (F24.4,2F24.2,2F24.3/)                                        HYDRO     664
      2380 FORMAT (120H                 FRICTION                 FRICTION       HYDRO     665
     +  LUBRICANT FLOW 1        LUBRICANT FLOW 2        LUBRICANT FLOW 3        HYDRO     666
     +)                                                                         HYDRO     667
      2390 FORMAT (120H                   (HP)                   (WATTS)       HYDRO     668
     +    (CU.IN./SEC.)           (CU.IN./SEC.)           (CU.IN./SEC.)        HYDRO     669
     +)                                                                         HYDRO     670
      2400 FORMAT (F24.5,F24.2,3F24.3/)                                         HYDRO     671
      2410 FORMAT (96H     FX--FORCE COMPONENT     FY--FORCE COMPONENT          HYDRO     672
     +       MX--MOMENT              MY--MOMENT)                               HYDRO     673
      2420 FORMAT (96H            (LBS)                   (LBS)                HYDRO     674
     +        (IN-LBS)                (IN-LBS) )                             HYDRO     675
                                                                                HYDRO     676
      2430 FORMAT (4F24.2/)                                                     HYDRO     677
      2440 FORMAT (6H  RE =,F12.0,5H  S =,F12.8,9H  KAPPA =,F12.4,6H  KX =,F1   HYDRO     678
     +2.2,6H  KZ =,F12.2/)                                                      HYDRO     679
      2450 FORMAT (12H  1/(KX*S) =,F12.5,20H  L/D *SQRT (KZ/KX)=,F12.5,9H  AL   HYDRO     680
     +PHA =,F8.2/)                                                              HYDRO     681
      2460 FORMAT (105H    J      P         U BAR      W BAR        RE   CODE   HYDRO     682
     +    J      P         U BAR      W BAR        RE   CODE)                  HYDRO     683
      2470 FORMAT (I5,3F10.2,F10.0,F5.0,4X,I5,3F10.2,F10.0,F5.0)                HYDRO     684
      2480 FORMAT (5H  I =,I2)                                                  HYDRO     685
      2490 FORMAT (1H1)
```



62 5 0 0

APPENDIX C

THRUST BEARING PROGRAM LISTING

(95 PAGES)



62500

```
      OVERLAY ( FILE0, 0, 0)                                                    FOIL      2
      PROGRAM FOIL (INPUT=65,OUTPUT=513,TAPE5=INPUT,TAPE60=TAPE5,               FOIL      3
     1 TAPE6=OUTPUT,TAPE61=TAPE6, TAPE4=65, TAPE3=65, TAPE13=65,                FOIL      4
     2 TAPE62=65,TAPE63=65,TAPE64=65,TAPE65=65 )                                FOIL      5
C                                                                               FOIL      6
C     FOIL THRUST BEARING ANALYSIS PROGRAM,  1/7/74                             FOIL      7
C                                                                               FOIL      8
      COMMON / COUNT / KOUNTER, MFLAGF, OLDTFT, TOLERC                          FOIL      9
      DATA TOLERC / .01  /                                                      FOIL     10
      DATA KOUNTER / 1  / , KFILE / 5HFILE0 /                                   FOIL     11
C     FORCE OUTPUT ROUTINES RESIDENT                                            FOIL     12
      WRITE (61,1000)                                                           FOIL     13
 1000 FORMAT (/)                                                                FOIL     14
C     INPUT                                                                     FOIL     15
      CALL OVERLAY ( KFILE, 1, 0 )                                              FOIL     16
C     BEARING ANALYSIS                                                          FOIL     17
   10 CALL OVERLAY ( KFILE, 2, 0 )                                              FOIL     18
C     DISPLACEMENT / STRESS                                                     FOIL     19
      CALL OVERLAY ( KFILE, 3, 0 )                                              FOIL     20
      GO TO 10                                                                  FOIL     21
      END                                                                       FOIL     22
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62500

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      OVERLAY ( FILE0, 3, 0 )                                                    BOSS1S      2
      PROGRAM BOSS1S                                                             BOSS1S      3
C **                                                                             BOSS1S      4
C **  SPECIAL VERSION FOR PAT HO,  11/29/73                                      BOSS1S      5
C****                                                                            BOSS1S      6
C**** REVISED 11/16/74 FOR SKEW CAPABILITY (X-Y PLANE ONLY) AND                  BOSS1S      7
C*****     DIFFERENTIAL DISPLACEMENT CAPABILITY (DD = 0, ONLY)                   BOSS1S      8
C****                                                                            BOSS1S      9
C **                                                                             BOSS1S     10
      COMMON NODES,NELEM,E(720),PR(720),TH(720),X(400,3),NB(720,3),NODIS        BOSS1S     11
     1(400,6),BC(400,6),COMT(13),RPMX,RPMY,RPMZ,GAMMA,SPACE(18624)              BOSS1S     12
      COMMON /ARRAYS/ R(3,3),FK(9,9),T(9,9),S(18,18),SL(18,18),V(9,9),PT        BOSS1S     13
     1(1M)                                                                      BOSS1S     14
      COMMON /PARAM/ EX,ETA,X1,Y1,Z1,X2,Y2,Z2,X3,Y3,Z3,THICK                    BOSS1S     15
      COMMON /SPRGS/ NNSTIF,NSTIFF(12),XSTIFF(12),YSTIFF(12),ZSTIFF(12)         BOSS1S     16
     1 , XXSTIF(12),YYSTIF(12),ZZSTIF(12)                                       BOSS1S     17
      COMMON /KGCACL/ KKPASS,SIGX(720),SIGY(720),TAUXY(720)                     BOSS1S     18
      COMMON /THERML/ TMPT(720),TMPB(720),ALPHAT(720)                           BOSS1S     19
      COMMON/LOGIC/NROWS,NCOLM,NG,NUMBLK,NROW2                                  BOSS1S     20
      COMMON/SPECL/ KSPEC(400)                                                  BOSS1S     21
      COMMON / DISPL / DISP1(400,3),NG                                          BOSS1S     22
      COMMON / QPLOT / NRADST                                                   BOSS1S     23
      COMMON / RELAXF / RELAX                                                   BOSS1S     24
      COMMON /GEOMSF / SFGEOM                                                   BOSS1S     25
      COMMON / SKEW / NSKEW, ISKEW(10), SINT, COST                              BOSS1S     26
      COMMON / DDISP / NDDISP, I1DDSP(10), I2DDSP(10)                           BOSS1S     27
C                                                                               BOSS1S     28
      DATA KFILE / 5HFILE0 /                                                    BOSS1S     29
      NSKEW= 0                                                                  BOSS1S     30
C     PRELIM                                                                    BOSS1S     31
      CALL OVERLAY ( KFILE, 3, 1)                                               BOSS1S     32
      KPLOT= NROWS                                                              BOSS1S     33
      CALL OVERLAY (KFILE, 3, 6 )                                               BOSS1S     34
   92 CONTINUE                                                                  BOSS1S     35
C     ORGANIZE                                                                  BOSS1S     36
      CALL OVERLAY (KFILE, 3, 3 )                                               BOSS1S     37
C     SOLVE FOR DEFLECTIONS                                                     BOSS1S     38
      CALL OVERLAY ( KFILE, 3, 4 )                                              BOSS1S     39
C     SOLVE FOR STRESSES                                                        BOSS1S     40
  120 CALL OVERLAY ( KFILE, 3, 5 )                                              BOSS1S     41
      IF (KKPASS .NE. 0) GO TO 145                                              BOSS1S     42
      KKPASS=1                                                                  BOSS1S     43
      WRITE (6,240)                                                             BOSS1S     44
      GO TO 92                                                                  BOSS1S     45
  145 IF (NG .EQ. 3 .OR. KPLOT .EQ. 0) GO TO 10                                 BOSS1S     46
C     PLOT OUTPUT                                                               BOSS1S     47
      CALL OVERLAY ( KFILE, 3, 8 )                                              BOSS1S     48
   10 CONTINUE                                                                  BOSS1S     49
  240 FORMAT (17H0PASS 1 COMPLETED)                                             BOSS1S     50
      END                                                                       BOSS1S     51
```



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```
1                SUBROUTINE DIMERR (I)                                  BOSS1S    52
                 PRINT 10, I                                            BOSS1S    53
                 CALL EXIT                                              BOSS1S    54
                 C                                                      BOSS1S    55
5                10 FORMAT (31H0DIMENSION EXCEEDED IN OVERLAY ,A6)      BOSS1S    56
                 END                                                    BOSS1S    57
```



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```
      OVERLAY ( FILE0, 3, 1 )                                                    PRELIM     2
      PROGRAM PRELIM                                                             PRELIM     3
      DIMENSION LABEL(10)                                                        PRELIM     4
      COMMON NODES,NELEM,E(720),PR(720),TH(720),X(400,3),NB(720,3),NODIS         PRELIM     5
     1(400,6),BC(400,6),COMT(13),RPMX,RPMY,RPMZ,GAMMA,SPACE(18624)               PRELIM     6
      COMMON /ARRAYS/ R(3,3),FK(9,9),T(9,9),S(18,18),SL(18,18),V(9,9),PT         PRELIM     7
     1(18)                                                                       PRELIM     8
      COMMON /PARAM/ EX,ETA,X1,Y1,Z1,X2,Y2,Z2,X3,Y3,Z3,THICK                     PRELIM     9
      COMMON /SPRGS/ NNSTIF,NSTIFF(12),XSTIFF(12),YSTIFF(12),ZSTIFF(12)          PRELIM    10
      COMMON /KGCALC/ KKPASS,SIGX(720),SIGY(720),TAUXY(720)                      PRELIM    11
      COMMON /THERML/ TMPT(720),TMPB(720),ALPHAT(720)                            PRELIM    12
      COMMON/LOGIC/NROWS,NCOLM,NG,NUMBLK,NROW2                                   PRELIM    13
      COMMON/SPECL/ KSPEC(400)                                                   PRELIM    14
      COMMON / DISPL / DISPI(400,3),NG                                           PRELIM    15
      COMMON / QPLOT / NRADST                                                    PRELIM    16
      COMMON / GEOMSF / SFGEOM                                                   PRELIM    17
      DATA LABEL / 6HIMPELL,6HTURBIN,6HSTIFFN,6HPRINT ,6HEND   ,6HRTURBI         PRELIM    18
     1 , 6HOPLOT) ,6HRADIAL ,6HAXIAL  ,6HSCALE       /                          PRELIM    19
   10 WRITE(6,200)                                                               PRELIM    20
      KPLOT= 0                                                                   PRELIM    21
      SFGEOM= 0.                                                                 PRELIM    22
      IN= 63                                                                     PRELIM    23
   11 READ (IN,160) JOB                                                          PRELIM    24
      IF (EOF(IN)) 150,15                                                        PRELIM    25
   15 WRITE (6,170) JOB                                                          PRELIM    26
      DO 20 J=1,10                                                               PRELIM    27
      IF (LABEL(J).NE.JOB) GO TO 20                                              PRELIM    28
      IF (J .EQ. 10) GO TO 45                                                    PRELIM    29
      IF (J .GE. 8) GO TO 40                                                     PRELIM    30
      IF (J-6) 35,40,30                                                          PRELIM    31
   30 KPLOT=1                                                                    PRELIM    32
      GO TO 11                                                                   PRELIM    33
   35 CONTINUE                                                                   PRELIM    34
      IF (J-4) 40,11,50                                                          PRELIM    35
   40 NG=J                                                                       PRELIM    36
      GO TO 11                                                                   PRELIM    37
   45 SFGEOM= 1.                                                                 PRELIM    38
      GO TO 11                                                                   PRELIM    39
   20 CONTINUE                                                                   PRELIM    40
      GO TO 150                                                                  PRELIM    41
   50 CONTINUE                                                                   PRELIM    42
C     OPTION FOR TURBIN IS READ INTO E(7)                                        PRELIM    43
      READ (IN,190) EX,XT,XROOTS,(E(J),J=1,7)                                    PRELIM    44
      WRITE (6,180) EX,XT,XROOTS,(E(J),J=1,7)                                    PRELIM    45
      IF (E(6) .NE. 0. ) READ(IN,250) (PR(J), J=1,5 )                            PRELIM    46
      IF (E(6) .NE. 0.) WRITE(6,260) (PR(J),J=1,5)                               PRELIM    47
      IF (SFGEOM .EQ. 0.) GO TO 55                                               PRELIM    48
      READ (IN,190) SFGEOM                                                       PRELIM    49
      WRITE(6,280) SFGEOM                                                        PRELIM    50
      IF (SFGEOM .EQ. 0.) STOP                                                   PRELIM    51
   55 CONTINUE                                                                   PRELIM    52
C     ZERO PRESCRIBED FORCES/DISPLACEMENTS                                       PRELIM    53
      DO 60 K=1,2400                                                             PRELIM    54
      BC(K)=0.                                                                   PRELIM    55
   60 CONTINUE                                                                   PRELIM    56
      DO 65 K=1,720                                                              PRELIM    57
      ALPHAT(K)=0.                                                               PRELIM    58
```



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```
                TMPT(K)=70.                                                          PRELIM     59
                TMPB(K)=70.                                                          PRELIM     60
   60         65 CONTINUE                                                            PRELIM     61
                NROWS= KPLOT                                                         PRELIM     62
                KKPASS=0                                                             PRELIM     63
                READ (IN,570) COMT                                                   PRELIM     64
                IF (SFGEOM .NE. 0.) COMT(13)= 6HSCALED                               PRELIM     65
   65           GO TO 300                                                           PRELIM     66
              150 CALL EXIT                                                          PRELIM     67
              C                                                                      PRELIM     68
              160 FORMAT (A6)                                                        PRELIM     69
              170 FORMAT (1X,A6)                                                     PRELIM     70
   70         180 FORMAT (1H0,3E12.4 /                                  16X,7F15.2)  PRELIM     71
              190 FORMAT (10E7.0)                                                    PRELIM     72
              200 FORMAT (42H1PROGRAM 1198 (BOSS1),  4/ 9/73, CM=126000       /      PRELIM     73
                 +   23H * * SPECIAL VERSION **  /)                                 PRELIM     74
              250 FORMAT (21X,5F7.0)                                                 PRELIM     75
   75         260 FORMAT (16X,5F15.2)                                                PRELIM     76
              280 FORMAT (25H0GEOMETRY SCALE (LINEAR)=    F10.6, 20(1H*)     )       PRELIM     77
              570 FORMAT (13A6)                                                      PRELIM     78
              300 CONTINUE                                                           PRELIM     79
                  END                                                              PRELIM     80
```

```
      OVERLAY ( FILE0, 3, 3 )                                                    ORG        2
      PROGRAM ORG                                                                ORG        3
C******NOTE---CALCULATIONS FOR MASS AND MODE SHAPES HAVE BEEN REMOVED            ORG        4
C******OR CHANGED FROM PROGRAM 803                                              ORG        5
C                                                                                ORG        6
      COMMON NODES,NELEM,E(720),PR(720),TH(720),X(400,3),NB(720,3),NODIS         ORG        7
     1(400,6),BC(400,6),COMT(13),RPMX,RPMY,RPMZ,GAMMA,SPACE(18624)               ORG        8
      COMMON /SPRGS/ NNSTIF,NSTIFF(12),XSTIFF(12),YSTIFF(12),ZSTIFF(12)          ORG        9
      COMMON /KGCALC/ KKPASS,SIGX(720),SIGY(720),TAUXY(720)                      ORG       10
      COMMON /THERML/ TMPT(720),TMPB(720),ALPHAT(720)                            ORG       11
      COMMON/LOGIC/NROWS,NCOLM,NG,NUMBLK,NROW2                                   ORG       12
      COMMON/SPECL/ KSPEC(400)                                                   ORG       13
      COMMON / GEOMSF / SFGEOM                                                   ORG       14
  130 CALL ASSEMB (SPACE(193),NCOLM)                                             ORG       15
      END                                                                        ORG       16
```



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      SUBROUTINE ASSEMB (A,NOQQQ)                                          ASSEMB     2
      DIMENSION A(NQQQQ,1)                                                 ASSEMB     3
      DIMENSION LM(3)                                                      ASSEMB     4
      COMMON NODES,NELEM,E(720),PR(720),TH(720),X(400,3),NB(720,3),NODIS   ASSEMB     5
     1(400,6),BC(400,6),COMT(13),RPMX,RPMY,RPMZ,GAMMA,B(192),QQ(1M432)     ASSEMB     6
      COMMON /ARRAYS/ R(3,3),FR(9,9),T(9,9),S(18,18),SL(18,18),V(9,9),PT   ASSEMB     7
     1(18)                                                                 ASSEMB     8
      COMMON /PARAM/ EX,ETA,X1,Y1,Z1,X2,Y2,Z2,X3,Y3,Z3,THICK               ASSEMB     9
      COMMON / NEED/ NL, NM, NFPN, KSHIFT                                  ASSEMB    10
      COMMON /SPRGS/ NNSTIF,NSTIFF(12),XSTIFF(12),YSTIFF(12),ZSTIFF(12)    ASSEMB    11
     1 , XXSTIF(12), YYSTIF(12), ZZSTIF(12)                                ASSEMB    12
      COMMON /LOGIC/NROWS,NCOLM,NW,NUMBLK,NH,NM2                           ASSEMB    13
      COMMON/SPECL/ KSPEC(400)                                             ASSEMB    14
      COMMON / DDISP / NDDISP, I1DDSP(10), I2DDSP(10)                      ASSEMB    15
      COMMON / SKEW / NSKEW, ISKEW(10), SINT, COST                         ASSEMB    16
      COMMON / TRI / N1,N2,N3,P(18)                                        ASSEMB    17
      COMMON / KGCALC/ KKPASS                                              ASSEMB    18
      COMMON / DISPL / DISP1(400,3),NG                                     ASSEMB    19
      DIMENSION DXYZ(9)                                                    ASSEMB    20
      CONX=GAMMA*RPMX**2                                                   ASSEMB    21
      CONY=GAMMA*RPMY**2                                                   ASSEMB    22
      CONZ=GAMMA*RPMZ**2                                                   ASSEMB    23
C     THE STIFFNESS MATRIX IS FORMED IN BLOCKS OF (NCOLS X NCOLS)          ASSEMB    24
      NUMBLK=0                                                             ASSEMB    25
C***                                                                       ASSEMB    26
      NFPN= 6                                                              ASSEMB    27
      NL=1                                                                 ASSEMB    28
      REWIND 13                                                            ASSEMB    29
      REWIND 4                                                             ASSEMB    30
      DO 10 N=1,9                                                          ASSEMB    31
   10 DXYZ(N)= 0.                                                          ASSEMB    32
      SUMFZ= 0.                                                            ASSEMB    33
      SUMXFZ= 0.                                                           ASSEMB    34
      SUMYFZ= 0.                                                           ASSEMB    35
      DO 20 N=1,NROWS                                                      ASSEMB    36
      B(N)=0.                                                              ASSEMB    37
      DO 20 M=1,NCOLM                                                      ASSEMB    38
   20 A(M,N)= 0.                                                           ASSEMB    39
   30 NUMBLK=NUMBLK+1                                                      ASSEMB    40
C     FORM BLOCK FOR ELEMENTS NL THROUGH NM                                ASSEMB    41
      NH=NL+NW-1                                                           ASSEMB    42
      NH=NM+NW-1                                                           ASSEMB    43
      KSHIFT=6*(NL-1)                                                      ASSEMB    44
      DO 90 N=1,NELEM                                                      ASSEMB    45
      N1=NB(N,1)                                                           ASSEMB    46
C     IF N1 .LT. 0, THIS ELEMENT HAS ALREADY BEEN ASSEMBLED                ASSEMB    47
      IF (N1.LT.0) GO TO 90                                                ASSEMB    48
C     CHECK IF ANY NODE OF THIS ELEMENT IS IN THIS BLOCK                   ASSEMB    49
      DO 40 I=1,3                                                          ASSEMB    50
      IF(NB(N,I).GE.NL.AND.NB(N,I).LE.NM) GO TO 50                         ASSEMB    51
   40 CONTINUE                                                             ASSEMB    52
      GO TO 90                                                             ASSEMB    53
C     FORM ELEMENT STIFFNESS MATRIX                                        ASSEMB    54
   50 N2=NB(N,2)                                                           ASSEMB    55
      N3=NB(N,3)                                                           ASSEMB    56
      EX=E(N)                                                              ASSEMB    57
      ETA=PR(N)                                                            ASSEMB    58
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      X1=X(N1,1)                                                                ASSEMB   59
      Y1=X(N1,2)                                                                ASSEMB   60
60    Z1=X(N1,3)                                                                ASSEMB   61
      X2=X(N2,1)                                                                ASSEMB   62
      Y2=X(N2,2)                                                                ASSEMB   63
      Z2=X(N2,3)                                                                ASSEMB   64
      X3=X(N3,1)                                                                ASSEMB   65
65    Y3=X(N3,2)                                                                ASSEMB   66
      Z3=X(N3,3)                                                                ASSEMB   67
      THICK=TH(N)                                                               ASSEMB   68
      DO 55 I=4,18                                                              ASSEMB   69
   55 P(I)=0.                                                                   ASSEMB   70
70    IF (KKPASS .EQ. 0) GO TO 58                                               ASSEMB   71
      DXYZ(1)= DISPL(N1,1)                                                      ASSEMB   72
      DXYZ(2)= DISPL(N1,2)                                                      ASSEMB   73
      DXYZ(3)= DISPL(N1,3)                                                      ASSEMB   74
      DXYZ(4)= DISPL(N2,1)                                                      ASSEMB   75
75    DXYZ(5)= DISPL(N2,2)                                                      ASSEMB   76
      DXYZ(6)= DISPL(N2,3)                                                      ASSEMB   77
      DXYZ(7)= DISPL(N3,1)                                                      ASSEMB   78
      DXYZ(8)= DISPL(N3,2)                                                      ASSEMB   79
      DXYZ(9)= DISPL(N3,3)                                                      ASSEMB   80
80    58 P(1)= (CONY + CONZ) * (X1 + DXYZ(1))                                   ASSEMB   81
      P(2)= (CONX + CONZ) * (Y1 + DXYZ(2))                                      ASSEMB   82
      P(3)= (CONX + CONY) * (Z1 + DXYZ(3))                                      ASSEMB   83
      P(7)= (CONY + CONZ) * (X2 + DXYZ(4))                                      ASSEMB   84
      P(8)= (CONX + CONZ) * (Y2 + DXYZ(5))                                      ASSEMB   85
85    P(9) = (CONX + CONY) * (Z2 + DXYZ(6))                                     ASSEMB   86
      P(13)= (CONY + CONZ) * (X3 + DXYZ(7))                                     ASSEMB   87
      P(14)= (CONX + CONZ) * (Y3 + DXYZ(8))                                     ASSEMB   88
      P(15)= (CONX + CONY) * (Z3 + DXYZ(9))                                     ASSEMB   89
      CALL TRIANG (N,TWODEL)                                                    ASSEMB   90
90    VOL03=TWODEL*THICK/6.                                                     ASSEMB   91
      DO 60 I=1,18                                                              ASSEMB   92
   60 P(I)=P(I)*VOL03                                                           ASSEMB   93
      SUMFZ= SUMFZ + P(3) + P(9) + P(15)                                        ASSEMB   94
      SUMXFZ= SUMXFZ + P(3) * X(N1,1) + P(9)* X(N2,1) + P(15) * X(N3,1)         ASSEMB   95
95    SUMYFZ= SUMYFZ + P(3) * X(N1,2) + P(9)* X(N2,2) + P(15) * X(N3,2)         ASSEMB   96
C     SET FIRST NODE NEGATIVE                                                   ASSEMB   97
      NB(N,1)=-NB(N,1)                                                          ASSEMB   98
C     ADD ELEMENT STIFFNESS TO OVERALL STIFFNESS                                ASSEMB   99
      LM(1)=6*(N1-1)-KSHIFT                                                     ASSEMB  100
100   LM(2)=6*(N2-1)-KSHIFT                                                     ASSEMB  101
      LM(3)=6*(N3-1)-KSHIFT                                                     ASSEMB  102
      DO 80 I=1,3                                                               ASSEMB  103
      DO 80 K=1,6                                                               ASSEMB  104
      II=LM(I)+K                                                                ASSEMB  105
105   KK=6*(I-1)+K                                                              ASSEMB  106
C     ADD IN ELEMENT FORCES (DUE TO ROTATION)                                   ASSEMB  107
C     ADD IN EQUIVALENT FORCES FOR INITIAL THERMAL STRAINS                      ASSEMB  108
      B(II)=B(II)+P(KK)+PT(KK)                                                  ASSEMB  109
      DO 80 J=1,3                                                               ASSEMB  110
110   DO 80 L=1,6                                                               ASSEMB  111
      JJ=LM(J)+L-II+1                                                           ASSEMB  112
      LL=6*(J-1)+L                                                              ASSEMB  113
      IF (JJ.LE.0) GO TO 80                                                     ASSEMB  114
      IF (JJ.LE.NCOLM) GO TO 70                                                 ASSEMB  115
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115                 PRINT 220, N                                                    ASSEMB  116
                    CALL EXIT                                                       ASSEMB  117
                 70 A(JJ,II)= A(JJ,II) + S(KK,LL)                                   ASSEMB  118
                 80 CONTINUE                                                        ASSEMB  119
                 90 CONTINUE                                                        ASSEMB  120
120                 IF (NSKEW .GT. 0) CALL SKEWED (Q9, Q10, A, NCOLM )              ASSEMB  121
                    IF (NDDISP.GT.0) CALL DUSPED (Q9, Q10, A, NCOLM )               ASSEMB  122
               C    ADD APPLIED FORCES ON THIS BLOCK                                ASSEMB  123
                    BIGA= 1.0                                                       ASSEMB  124
                    DO 130 N=NL,NM                                                  ASSEMB  125
125                 IF (N.GT.NODES) GO TO 140                                       ASSEMB  126
                    J=6*(N-1)-KSHIFT+1                                              ASSEMB  127
                    JJ=J+5                                                          ASSEMB  128
                    KK=1                                                            ASSEMB  129
                    DO 100 K=J,JJ                                                   ASSEMB  130
130                 B(K)=B(K)+BC(N,KK)                                              ASSEMB  131
                    IF (A(1,K) .GT. BIGA) BIGA= A(1,K)                              ASSEMB  132
                100 KK=KK+1                                                         ASSEMB  133
               C    ADD SPRING RATES, IF ANY                                        ASSEMB  134
                    IF (NNSTIF.EQ.0) GO TO 130                                      ASSEMB  135
135                 DO 110 K=1,NNSTIF                                               ASSEMB  136
                    KK=K                                                            ASSEMB  137
                    IF (NSTIFF(K).EQ.N) GO TO 120                                   ASSEMB  138
                110 CONTINUE                                                        ASSEMB  139
                    GO TO 130                                                       ASSEMB  140
140                 120 A(1,J)= A(1,J) + XSTIFF(KK)                                 ASSEMB  141
                    J=J+1                                                           ASSEMB  142
                    A(1,J)= A(1,J) + YSTIFF(KK)                                     ASSEMB  143
                    J=J+1                                                           ASSEMB  144
                    A(1,J)= A(1,J) + ZSTIFF(KK)                                     ASSEMB  145
145                 J= J + 1                                                        ASSEMB  146
                    A(1,J)= A(1,J) + XXSTIF(KK)                                     ASSEMB  147
                    J= J + 1                                                        ASSEMB  148
                    A(1,J)= A(1,J) + YYSTIF(KK)                                     ASSEMB  149
                    J= J + 1                                                        ASSEMB  150
150                 A(1,J)= A(1,J) + ZZSTIF(KK)                                     ASSEMB  151
                130 CONTINUE                                                        ASSEMB  152
               C    MODIFY A AND B FOR SPECIFIES DISPLACEMENTS.                     ASSEMB  153
               C    NOTE THAT NODES THROUGH NH WILL AFFECT THIS BLOCK               ASSEMB  154
                140 DO 160 N=NL,NH                                                  ASSEMB  155
155                 IF (N.GT.NODES) GO TO 170                                       ASSEMB  156
                    J=6*(N-1)-KSHIFT+1                                              ASSEMB  157
                    JJ=J+5                                                          ASSEMB  158
                    KK=1                                                            ASSEMB  159
                    DO 150 K=J,JJ                                                   ASSEMB  160
160                 IF (NODIS(N,KK).NE.3) GO TO 150                                 ASSEMB  161
                    CALL MODIFY (NROWS,K,BC(N,KK),A,B,NCOLM)                        ASSEMB  162
                150 KK=KK+1                                                         ASSEMB  163
                    IF (NDDISP .EQ. 0 .OR.   N .GT. NM) GO TO 160                   ASSEMB  164
                    DO 570 K=1,NDDISP                                               ASSEMB  165
165                 IF (N .NE. I1DDSP(K)) GO TO 570                                 ASSEMB  166
                    KK= (I2DDSP(K) - N) * 6    + 1                                  ASSEMB  167
                    DO 566 L=J,JJ                                                   ASSEMB  168
                    A(KK,L)= -1.                                                    ASSEMB  169
                566 B(L)= 0.                                                        ASSEMB  170
170                 570 CONTINUE                                                    ASSEMB  171
                160 CONTINUE                                                        ASSEMB  172
```

```
      C     CHECK IF ANY SPECIAL NODES IN THIS BLOCK                                ASSEMB  173
        170 DO 205 N= NL,NM                                                         ASSEMB  174
            IF (N .GT. NODES) GO TO 206                                             ASSEMB  175
      175   J= 6*(N-1) -KSHIFT +1                                                   ASSEMB  176
            CALL SPECLN (N,J,A,NCOLM)                                               ASSEMB  177
        205 CONTINUE                                                                ASSEMB  178
        206 CONTINUE                                                                ASSEMB  179
            BIGA= BIGA * 1.E-7                                                      ASSEMB  180
      180   C     BLOCK IS NOW COMPLETE                                             ASSEMB  181
            C     CHECK DIAGONAL FOR NEGLIGIBLE STIFFNESS AND CHANGE DISPLACEMENT   ASSEMB  182
            C           TO ZERO                                                     ASSEMB  183
            DO 190 N=NL,NM                                                          ASSEMB  184
            IF (N.GT.NODES) GO TO 200                                               ASSEMB  185
      185   J=6*(N-1)-KSHIFT+1                                                      ASSEMB  186
            JJ=J+5                                                                  ASSEMB  187
            IF (N .LE. NM) GO TO 174                                                ASSEMB  188
            IF (KSPEC(N) .EQ. 0) GO TO 190                                          ASSEMB  189
            CALL MODIFY (NROWS,JJ, 0.0,A,B,NCOLM)                                   ASSEMB  190
      190   GO TO 190                                                               ASSEMB  191
        174 DO 180 K=J,JJ                                                           ASSEMB  192
            IF ( A(1,K) .GT. BIGA  .OR.  A(1,K) .EQ. 1.0) GO TO 179                 ASSEMB  193
        178 CALL MODIFY (NROWS,K,0.0,A,B,NCOLM)                                     ASSEMB  194
            GO TO 180                                                               ASSEMB  195
      195   179 IF (K .EQ. JJ  .AND.  KSPEC(N) .NE. 0) GO TO 178                    ASSEMB  196
        180 CONTINUE                                                                ASSEMB  197
        190 CONTINUE                                                                ASSEMB  198
        200 CONTINUE                                                                ASSEMB  199
      C     WRITE BLOCK                                                           ASSEMB  200
      200   LENGTH= NCOLM * NROW2                                                   ASSEMB  201
            BUFFER OUT (4,1) (A,A(LENGTH))                                          ASSEMB  202
            IF (UNIT(4)) 208,207,207                                                ASSEMB  203
        207 PRINT 1010                                                              ASSEMB  204
       1010 FORMAT (13H0BUFFER ERROR    )                                           ASSEMB  205
      205   CALL EXIT                                                               ASSEMB  206
        208 BUFFER OUT (13,1) (B,B(NROW2))                                          ASSEMB  207
            IF (UNIT(13)) 209,207,207                                               ASSEMB  208
        209 IF (NM .GE. NODES) GO TO 230                                            ASSEMB  209
      C     SHIFT LOWER BLOCK TO UPPER + ZERO LOWER                               ASSEMB  210
      210   DO 210 N=1,NROW2                                                        ASSEMB  211
            K=N+NROW2                                                               ASSEMB  212
            B(N)=B(K)                                                               ASSEMB  213
            B(K)=0.                                                                 ASSEMB  214
            DO 210 M=1,NCOLM                                                        ASSEMB  215
      215   A(M,N)= A(M,K)                                                          ASSEMB  216
        210 A(M,K)= 0.                                                              ASSEMB  217
            NL=NM+1                                                                 ASSEMB  218
            GO TO 30                                                                ASSEMB  219
        230 IF (NG .EQ. 2 .OR. NG .EQ. 6) WRITE(6,1000) SUMFZ,SUMXFZ,SUMYFZ         ASSEMB  220
      220   1000 FORMAT (30H0FOR CENTRIFUGAL LOADS ONLY--    /                      ASSEMB  221
           1        10H0SUM F(Z)=  E15.5/12H SUM X*F(Z)= E 15.5/12H SUM Y*F(Z)     ASSEMB  222
           1=  E15.5/)                                                              ASSEMB  223
            RETURN                                                                  ASSEMB  224
      C                                                                             ASSEMB  225
      225   220 FORMAT (17H0BAND EXCEEDED AT18)                                     ASSEMB  226
            END                                                                     ASSEMB  227
```



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CARD NR. SEVERITY DETAILS DIAGNOSIS OF PROBLEM

201 I A ARRAY NAME OPERAND NOT SUBSCRIPTED, FIRST ELEMENT WILL BE USED.
205 I B ARRAY NAME OPERAND NOT SUBSCRIPTED, FIRST ELEMENT WILL BE USED.

```
      SUBROUTINE SPECLN (N,JROW,A,NQQQQ)                                    SPECLN     2
      DIMENSION A(NQQQQ,1)                                                  SPECLN     3
      COMMON NODES,NELEM,E(720),PR(720),TH(720),X(400,3),NB(720,3),NODIS    SPECLN     4
     1(400,6),BC(400,6),COMT(13),RPMX,RPMY,RPMZ,GAMMA,B(192),QQ(18432)      SPECLN     5
      COMMON /ARRAYS/ R(3,3),FK(9,9),T(9,9),S(18,18),SL(18,18),V(9,9),PT    SPECLN     6
     1(18)                                                                  SPECLN     7
      COMMON /LOGIC/NROWS,NCOLM,NW,NUMBLK,NROW2                             SPECLN     8
      COMMON / DDISP / NDDISP, I1DDSP(10), I2DDSP(10)                       SPECLN     9
      COMMON / SKEW / NSKEW, ISKEW(10), SINT, COST                          SPECLN    10
      COMMON / NEED/ NL, NH, NFPN, KSHIFT                                   SPECLN    11
      COMMON/SPECL/ KSPEC(400)                                              SPECLN    12
      DIMENSION TUM(15),RUM(15), TUMRUM(15,2)                               SPECLN    13
      EQUIVALENCE (TUM,TUMRUM),(RUM,TUMRUM(1,2))                           SPECLN    14
C                                                                           SPECLN    15
C     A SPECIAL NODE I IS HANDLED IN THE LOCAL COORDINATE SYSTEM OF         SPECLN    16
C             ELEMENT KSPEC(I)                                              SPECLN    17
C                                                                           SPECLN    18
      IF (KSPEC(N) .EQ. 0) RETURN                                           SPECLN    19
C***** SHOULD NOT BE HERE -- LOGIC NOT NEEDED WITH BARS                     SPECLN    20
      PRINT 9999                                                            SPECLN    21
 9999 FORMAT (18H0TROUBLE IN SPECLN     )                                   SPECLN    22
      STOP                                                                  SPECLN    23
C                                                                           SPECLN    24
      ENTRY SKEWED                                                          SPECLN    25
C                                                                           SPECLN    26
C     MODIFY A, B FOR SKEWED NODES                                          SPECLN    27
C * * * THIS CODE IS FOR NFPN=6. BUT SKEW ONLY IN X-Y PLANE * * *          SPECLN    28
C                                                                           SPECLN    29
      DO 110 N=NL,NH                                                        SPECLN    30
      IF (N.GT.NODES) GO TO 120                                             SPECLN    31
      IF (KHEK(N).EQ.0) GO TO 110                                           SPECLN    32
      J=NFPN*(N-1)-KSHIFT+1                                                 SPECLN    33
C     TRANSFORM LOAD VECTOR (CENTRIF + THERMAL ONLY)                        SPECLN    34
      IF (J.GT.NROW2) GO TO 80                                              SPECLN    35
      DUM1=B(J)                                                             SPECLN    36
      DUM2=B(J+1)                                                           SPECLN    37
      B(J)=COST*DUM1+SINT*DUM2                                              SPECLN    38
      B(J+1)=COST*DUM2-SINT*DUM1                                            SPECLN    39
      DUM1= B(J+3)                                                          SPECLN    40
      DUM2= B(J+4)                                                          SPECLN    41
      B(J+3)= COST * DUM1 + SINT * DUM2                                     SPECLN    42
      B(J+4)= COST * DUM2 - SINT * DUM1                                     SPECLN    43
C     TRANSFORM STIFFNESS MATRIX                                            SPECLN    44
   80 CONTINUE                                                              SPECLN    45
      DO 100 M=7,NCOLM,6                                                    SPECLN    46
      K=J-M+1                                                               SPECLN    47
      IF (K.LE.0.OR.K.GT.NROW2) GO TO 90                                    SPECLN    48
      CALL TBYA (A(M,K),A(M,K+1),A(M-1,K+1),A(M+1,K),A(M-2,K+2),A(M-1,K+    SPECLN    49
     1 2) )                                                                 SPECLN    50
      CALL TBYA (A(M-3,K+3),A(M-3,K+4),A(M-4,K+4),A(M-2,K+3),A(M-5,K+5),    SPECLN    51
     1 A(M-4,K+5) )                                                         SPECLN    52
      CALL TBYA (A(M+3,K),A(M+3,K+1),A(M+2,K+1),A(M+4,K),A(M+1,K+2),        SPECLN    53
     1 A(M+2,K+2) )                                                         SPECLN    54
      CALL TBYA (A(M,K+3),A(M,K+4),A(M-1,K+4),A(M+1,K+3),A(M-2,K+5),        SPECLN    55
     1 A(M-1,K+5) )                                                         SPECLN    56
   90 IF (J.GT.NROW2) GO TO 100                                             SPECLN    57
      CALL ABYTT (A(M,J),A(M,J+1),A(M-1,J+1),A(M+1,J),A(M+2,J),             SPECLN    58
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     1 A(M+1,J+1) )                                                          SPECLN     59
      CALL ABYTT (A(M-3,J+3),A(M-3,J+4),A(M-4,J+4),A(M-2,J+3),A(M-1,J+3)     SPECLN     60
60   1 ,A(M-2,J+4) )                                                         SPECLN     61
      CALL ABYTT (A(M+3,J),A(M+3,J+1),A(M+2,J+1),A(M+4,J),A(M+5,J),          SPECLN     62
     1 A(M+4,J+1) )                                                          SPECLN     63
      CALL ABYTT (A(M,J+3),A(M,J+4),A(M-1,J+4),A(M+1,J+3),A(M+2,J+3),        SPECLN     64
     1 A(M+1,J+4) )                                                          SPECLN     65
65  100 CONTINUE                                                            SPECLN     66
      IF (J.GT.NROW2) GO TO 110                                             SPECLN     67
      DUM1=A(2,J)                                                           SPECLN     68
      DUM2= A(3,4)                                                          SPECLN     69
      DUM3= A(2,J+1)                                                        SPECLN     70
70    CALL TBYA (A(1,J),A(1,J+1),DUM1,A(2,J),DUM2,DUM3)                     SPECLN     71
      CALL ABYTT (A(1,J),A(1,J+1),DUM1,A(2,J),A(3,J),A(2,J+1) )             SPECLN     72
      CALL TBYA (A(4,J),A(4,J+1),A(3,J+1),A(5,J),A(2,J+2),A(3,J+2) )        SPECLN     73
      CALL ABYTT(A(4,J),A(4,J+1),A(3,J+1),A(5,J),A(6,J),A(5,J+1) )          SPECLN     74
      DUM1= A(2,J+3)                                                        SPECLN     75
75    DUM2= A(3,J+3)                                                        SPECLN     76
      DUM3= A(2,J+4)                                                        SPECLN     77
      CALL TBYA (A(1,J+3),A(1,J+4),DUM1,A(2,J+3),DUM2,DUM3)                 SPECLN     78
      CALL ABYTT(A(1,J+3),A(1,J+4),DUM1,A(2,J+3),A(3,J+3),A(2,J+4) )        SPECLN     79
  110 CONTINUE                                                              SPECLN     80
80  120 RETURN                                                              SPECLN     81
C                                                                           SPECLN     82
      ENTRY DDSPED                                                          SPECLN     83
C                                                                           SPECLN     84
      DO 490 N=NL,NH                                                        SPECLN     85
85    IF (N.GT.NODES) GO TO 500                                             SPECLN     86
  140 DO 150 II=1,NDDISP                                                    SPECLN     87
      I=II                                                                  SPECLN     88
      IF (N.EQ. I1DDSP(II) ) GO TO 160                                      SPECLN     89
      IF (N.EQ. I2DDSP(II) ) GO TO 180                                      SPECLN     90
90  150 CONTINUE                                                            SPECLN     91
      GO TO 490                                                             SPECLN     92
  160 DO 165 L=1,6                                                          SPECLN     93
      NODIS(N,L)= 3                                                         SPECLN     94
  165 BC(N,L)= 0.                                                           SPECLN     95
95    GO TO 490                                                             SPECLN     96
  180 LL= I1DDSP(I)                                                         SPECLN     97
      L=NFPN*(LL-1)-KSHIFT+1                                                SPECLN     98
      IF (L.LE.0) GO TO 490                                                 SPECLN     99
  280 J=NFPN*(N-1)-KSHIFT+1                                                 SPECLN    100
100   LJ=L-J                                                                SPECLN    101
C     ADD ROWS AND COLUMNS                                                  SPECLN    102
C * * * CODE FOR NFPN= 6, SKEWED IN X-Y PLANE ONLY                        SPECLN    103
C     FIRST, DIAGONAL AREA (6 X 6)                                          SPECLN    104
      IF (L.GT.NROW2) GO TO 310                                             SPECLN    105
105   MM=1-LJ                                                               SPECLN    106
      IF (J.LT.NROW2) GO TO 290                                             SPECLN    107
      M=KHEK(N)                                                             SPECLN    108
      IF (M.EQ.0) GO TO 290                                                 SPECLN    109
C     UNTRANSFORMED AREA                                                    SPECLN    110
110   MQ= 0                                                                 SPECLN    111
  285 DUM1= A(2,J)                                                          SPECLN    112
      DUM2= A(3,J)                                                          SPECLN    113
      DUM3= A(2,J+1)                                                        SPECLN    114
      CALL TBYA (A(1,J),A(1,J+1),DUM1,A(2,J), DUM2, DUM3)                   SPECLN    115
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      CALL ABYTT(A(1,J),A(1,J+1),DUM1,A(2,J), A(3,J),A(2,J+1) )                 SPECLN  116
      CALL TRYA (A(4,J),A(4,J+1),A(3,J+1),A(5,J),A(2,J+2),A(3,J+2) )            SPECLN  117
      CALL ABYTT(A(4,J),A(4,J+1),A(3,J+1),A(5,J),A(6,J),A(5,J+1) )              SPECLN  118
      DUM1= A(2,J+3)                                                            SPECLN  119
      DUM2= A(3,J+3)                                                            SPECLN  120
      DUM3= A(2,J+4)                                                            SPECLN  121
      CALL TRYA (A(1,J+3),A(1,J+4),DUM1,A(2,J+3),DUM2,DUM3)                     SPECLN  122
      CALL ABYTT(A(1,J+3),A(1,J+4),DUM1,A(2,J+3),A(3,J+3),A(2,J+4) )            SPECLN  123
      IF (MU .NE. 0) GO TO 305                                                  SPECLN  124
  290 A(1,J)= A(1,J) + 1. + A(MM,L) * 2. + A(1,L)                               SPECLN  125
      A(1,J+1)= A(1,J+1) + 1. + A(MM,L+1) * 2. + A(1,L+1)                       SPECLN  126
      A(1,J+2)= A(1,J+2) + 1. + A(MM,L+2) * 2. + A(1,L+2)                       SPECLN  127
      A(1,J+3)= A(1,J+3) + 1. + A(MM,L+3) * 2. + A(1,L+3)                       SPECLN  128
      A(1,L+4)= A(1,J+4) + 1. + A(MM,L+4) * 2. + A(1,L+4)                       SPECLN  129
      A(1,J+5)= A(1,J+5) + 1. + A(MM,L+5) * 2. + A(1,L+5)                       SPECLN  130
      A(2,J)= A(2,J) + A(MM-1,L+1)+A(2,L) + A(MM+1,L)                           SPECLN  131
      A(2,J+1)= A(2,J+1) + A(MM-1,L+2) + A(2,L+1) + A(MM+1,L+1)                 SPECLN  132
      A(2,J+2)= A(2,J+2) + A(MM-1,L+3) + A(2,L+2) + A(MM+1,L+2)                 SPECLN  133
      A(2,J+3)= A(2,J+3) + A(MM-1,L+4) + A(2,L+3) + A(MM+1,L+3)                 SPECLN  134
      A(2,J+4)= A(2,J+4) + A(MM-1,L+5) + A(2,L+4) + A(MM+1,L+4)                 SPECLN  135
      A(3,J)= A(3,J) + A(MM-2,L+2   ) + A(3,L) + A(MM+2,L)                      SPECLN  136
      A(3,J+1)= A(3,J+1) + A(MM-2,L+3) + A(3,L+1) + A(MM+2,L+1)                 SPECLN  137
      A(3,J+2)= A(3,J+2) + A(MM-2,L+4) + A(3,L+2) + A(MM+2,L+2)                 SPECLN  138
      A(3,J+3)= A(3,J+3) + A(MM-2,L+5) + A(3,L+3) + A(MM+2,L+3)                 SPECLN  139
      A(4,J)= A(4,J) + A(MM-3,L+3) + A(4,L) + A(MM+3,L)                         SPECLN  140
      A(4,J+1)= A(4,J+1) + A(MM-3,L+4) + A(4,L+1) + A(MM+3,L+1)                 SPECLN  141
      A(4,J+2)= A(4,J+2) + A(MM-3,L+5) + A(4,L+2) + A(MM+3,L+2)                 SPECLN  142
      A(5,J)= A(5,J) + A(MM-4,L+4) + A(5,L) + A(MM+4,L)                         SPECLN  143
      A(5,J+1)= A(5,J+1) + A(MM-4,L+5) + A(5,L+1) + A(MM+4,L+1)                 SPECLN  144
      A(6,J)= A(6,J) + A(MM-5,L+5) + A(6,L) + A(MM+5,L)                         SPECLN  145
  300 IF (J.LT.NROW2) GO TO 310                                                 SPECLN  146
      IF (M.EQ.0) GO TO 310                                                     SPECLN  147
C     TRANSFORM BACK                                                            SPECLN  148
      SINT=-SINT                                                                SPECLN  149
      MU= 1                                                                     SPECLN  150
      GO TO 285                                                                 SPECLN  151
  305 SINT= -SINT                                                               SPECLN  152
C     SECOND, ROWS ONLY                                                         SPECLN  153
  310 DO 390 M=7,NCOLM,6                                                        SPECLN  154
      K=J-M+1                                                                   SPECLN  155
      IF (K.LE.0) GO TO 400                                                     SPECLN  156
      NN=LJ+M                                                                   SPECLN  157
      IF (NN.GT.0) GO TO 320                                                    SPECLN  158
      MM=2-NN                                                                   SPECLN  159
      KK=L                                                                      SPECLN  160
      GO TO 330                                                                 SPECLN  161
  320 KK=L-NN+1                                                                 SPECLN  162
      MM=NN                                                                     SPECLN  163
  330 IF (KK.GT.NROW2) GO TO 390                                                SPECLN  164
      IF (K.LT.NROW2) GO TO 350                                                 SPECLN  165
      N1=KHEK(N)                                                                SPECLN  166
      IF (N1.EQ.0) GO TO 340                                                    SPECLN  167
C     UNTRANSFORMED AREA                                                        SPECLN  168
      MU= 0                                                                     SPECLN  169
  335 CALL TRYA (A(M,K),A(M,K+1),A(M-1,K+1),A(M+1,K),A(M-2,K+2),                SPECLN  170
     1 A(M-1,K+2) )                                                             SPECLN  171
      CALL TRYA (A(M-3,K+3),A(M-3,K+4),A(M-4,K+4),A(M-2,K+3),A(M-5,K+5),        SPECLN  172
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     1 A(M-4,K+5) )                                                          SPECLN   173
      CALL TBYA (A(M+3,K),A(M+3,K+1),A(M+2,K+1),A(M+4,K),A(M+1,K+2),         SPECLN   174
     1 A(M+2,K+2) )                                                          SPECLN   175
      CALL TBYA (A(M,K+3),A(M,K+4),A(M-1,K+4),A(M+1,K+3),A(M-2,K+5),         SPECLN   176
     1 A(M-1,K+5) )                                                          SPECLN   177
      IF (MQ .NE. 0) GO TO 375                                               SPECLN   178
  340 LL= K - (M/6)                                                          SPECLN   179
      N2=KHEK(LL)                                                            SPECLN   180
      IF (N2.EQ.0) GO TO 350                                                 SPECLN   181
C     UNTRANSFORMED AREA                                                     SPECLN   182
      MQ= 0                                                                  SPECLN   183
  345 CALL ABYTT (A(M,K),A(M,K+1),A(M-1,K+1),A(M+1,K),A(M+2,K),A(M+1,K+1     SPECLN   184
     1) )                                                                    SPECLN   185
      CALL ABYTT (A(M-3,K+3),A(M-3,K+4),A(M-4,K+4),A(M-2,K+3),A(M-1,K+3)     SPECLN   186
     1 , A(M-2,K+4) )                                                        SPECLN   187
      CALL ABYTT (A(M+3,K),A(M+3,K+1),A(M+2,K+1),A(M+4,K), A(M+5,K),         SPECLN   188
     1 A(M+4,K+1) )                                                          SPECLN   189
      CALL ABYTT (A(M,K+3),A(M,K+4),A(M-1,K+4),A(M+1,K+3),A(M+2,K+3),        SPECLN   190
     1 A(M+1,K+4) )                                                          SPECLN   191
      IF (MQ .NE. 0) GO TO 385                                               SPECLN   192
  350 A(M,K)= A(M,K) + A(MM,KK)                                              SPECLN   193
      A(M,K+1)= A(M,K+1) + A(MM,KK+1)                                        SPECLN   194
      A(M,K+2)= A(M,K+2) + A(MM,KK+2)                                        SPECLN   195
      A(M,K+3)= A(M,K+3) + A(MM,KK+3)                                        SPECLN   196
      A(M,K+4)= A(M,K+4) + A(MM,KK+4)                                        SPECLN   197
      A(M,K+5)= A(M,K+5) + A(MM,KK+5)                                        SPECLN   198
      TUM(1)= A(MM+1,KK)                                                     SPECLN   199
      TUM(2)= A(MM+2,KK)                                                     SPECLN   200
      TUM(3)= A(MM+3,KK)                                                     SPECLN   201
      TUM(4)= A(MM+4,KK)                                                     SPECLN   202
      TUM(5)= A(MM+5,KK)                                                     SPECLN   203
      TUM(6)= A(MM+1,KK+1)                                                   SPECLN   204
      TUM(7)= A(MM+2,KK+1)                                                   SPECLN   205
      TUM(8)= A(MM+3,KK+1)                                                   SPECLN   206
      TUM(9)= A(MM+4,KK+1)                                                   SPECLN   207
      TUM(10)= A(MM+1,KK+2)                                                  SPECLN   208
      TUM(11)= A(MM+2,KK+2)                                                  SPECLN   209
      TUM(12)= A(MM+3,KK+2)                                                  SPECLN   210
      TUM(13)= A(MM+1,KK+3)                                                  SPECLN   211
      TUM(14)= A(MM+2,KK+3)                                                  SPECLN   212
      TUM(15)= A(MM+1,KK+4)                                                  SPECLN   213
      RUM(1)= A(MM-1,KK+1)                                                   SPECLN   214
      RUM(2)= A(MM-2,KK+2)                                                   SPECLN   215
      RUM(3)= A(MM-3,KK+3)                                                   SPECLN   216
      RUM(4)= A(MM-4,KK+4)                                                   SPECLN   217
      RUM(5)= A(MM-5,KK+5)                                                   SPECLN   218
      RUM(6)= A(MM-1,KK+2)                                                   SPECLN   219
      RUM(7)= A(MM-2,KK+3)                                                   SPECLN   220
      RUM(8)= A(MM-3,KK+4)                                                   SPECLN   221
      RUM(9)= A(MM-4,KK+5)                                                   SPECLN   222
      RUM(10)= A(MM-1,KK+3)                                                  SPECLN   223
      RUM(11)= A(MM-2,KK+4)                                                  SPECLN   224
      RUM(12)= A(MM-3,KK+5)                                                  SPECLN   225
      RUM(13)= A(MM-1,KK+4)                                                  SPECLN   226
      RUM(14)= A(MM-2,KK+5)                                                  SPECLN   227
      RUM(15)= A(MM-1,KK+5)                                                  SPECLN   228
      MUF 1                                                                  SPECLN   229
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                IF (MM .NE. 1 .AND.NN .GT. 0) MO= 2                                SPECLN  230
230             A(M-1,K+1)= TUMRUM(1,MO)   + A(M-1,K+1)                            SPECLN  231
                A(M-2,K+2)= TUMRUM(2,MO)   + A(M-2,K+2)                            SPECLN  232
                A(M-3,K+3)= TUMRUM(3,MO)   + A(M-3,K+3)                            SPECLN  233
                A(M-4,K+4)= TUMRUM(4,MO)   + A(M-4,K+4)                            SPECLN  234
                A(M-5,K+5)= TUMRUM(5,MO)   + A(M-5,K+5)                            SPECLN  235
235             A(M-1,K+2)= TUMRUM(6,MO)   + A(M-1,K+2)                            SPECLN  236
                A(M-2,K+3)= TUMRUM(7,MO)   + A(M-2,K+3)                            SPECLN  237
                A(M-3,K+4)= TUMRUM(8,MO)   + A(M-3,K+4)                            SPECLN  238
                A(M-4,K+5)= TUMRUM(9,MO)   + A(M-4,K+5)                            SPECLN  239
                A(M-1,K+3)= TUMRUM(10,MO)  + A(M-1,K+3)                            SPECLN  240
240             A(M-2,K+4)= TUMRUM(11,MO)  + A(M-2,K+4)                            SPECLN  241
                A(M-3,K+5)= TUMRUM(12,MO)  + A(M-3,K+5)                            SPECLN  242
                A(M-1,K+4)= TUMRUM(13,MO)  + A(M-1,K+4)                            SPECLN  243
                A(M-2,K+5)= TUMRUM(14,MO)  + A(M-2,K+5)                            SPECLN  244
                A(M-1,K+5)= TUMRUM(15,MO)  + A(M-1,K+5)                            SPECLN  245
245             MO= 2                                                              SPECLN  246
                IF (NN .GT. 0) MO= 1                                               SPECLN  247
                A(M+1,K  )= TUMRUM( 1,MO) + A(M+1,K  )                             SPECLN  248
                A(M+2,K  )= TUMRUM( 2,MO) + A(M+2,K  )                             SPECLN  249
                A(M+3,K  )= TUMRUM( 3,MO) + A(M+3,K  )                             SPECLN  250
250             A(M+4,K  )= TUMRUM( 4,MO) + A(M+4,K  )                             SPECLN  251
                A(M+5,K  )= TUMRUM( 5,MO) + A(M+5,K  )                             SPECLN  252
                A(M+1,K+1)= TUMRUM( 6,MO) + A(M+1,K+1)                             SPECLN  253
                A(M+2,K+1)= TUMRUM( 7,MO) + A(M+2,K+1)                             SPECLN  254
                A(M+3,K+1)= TUMRUM( 8,MO) + A(M+3,K+1)                             SPECLN  255
255             A(M+4,K+1)= TUMRUM( 9,MO) + A(M+4,K+1)                             SPECLN  256
                A(M+1,K+2)= TUMRUM(10,MO) + A(M+1,K+2)                             SPECLN  257
                A(M+2,K+2)= TUMRUM(11,MO) + A(M+2,K+2)                             SPECLN  258
                A(M+3,K+2)= TUMRUM(12,MO) + A(M+3,K+2)                             SPECLN  259
                A(M+1,K+3)= TUMRUM(13,MO) + A(M+1,K+3)                             SPECLN  260
260             A(M+2,K+3)= TUMRUM(14,MO) + A(M+2,K+3)                             SPECLN  261
                A(M+1,K+4)= TUMRUM(15,MO) + A(M+1,K+4)                             SPECLN  262
              370 IF (K.LT.NROW2) GO TO 390                                        SPECLN  263
                  IF (N1.EQ.0) GO TO 380                                           SPECLN  264
                  IF (N2.NE.0) N1=KHEK(N)                                          SPECLN  265
265           C     TRANSFORM BACK                                                 SPECLN  266
                  SINT=-SINT                                                       SPECLN  267
                  MO= 1                                                            SPECLN  268
                  GO TO 335                                                        SPECLN  269
              375 SINT= - SINT                                                     SPECLN  270
270           380 IF (N2.EQ.0) GO TO 390                                           SPECLN  271
                  IF (N1.NE.0) N2=KHEK(LL)                                         SPECLN  272
                  SINT=-SINT                                                       SPECLN  273
                  MO= 1                                                            SPECLN  274
                  GO TO 345                                                        SPECLN  275
275           385 SINT= - SINT                                                     SPECLN  276
              390 CONTINUE                                                         SPECLN  277
                C     THIRD, COLS. ONLY                                          SPECLN  278
              400 IF (L.GT.NROW2) GO TO 490                                        SPECLN  279
                  LL=N                                                             SPECLN  280
280               DO 460 M=7,NCOLM,6                                               SPECLN  281
                  MM=M-LJ                                                          SPECLN  282
                  IF (MM.GT.NCOLM) GO TO 470                                       SPECLN  283
                  LL=LL+1                                                          SPECLN  284
                  IF (LL.GT.NODES) GO TO 470                                       SPECLN  285
285               IF (J.LT.NROW2) GO TO 420                                        SPECLN  286
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                N1=KMEK(N)                                                      SPECLN  287
                IF (N1.EQ.0) GO TO 410                                          SPECLN  288
              C UNTRANSFORMED AREA                                              SPECLN  289
                MQ= 0                                                           SPECLN  290
  290         405 CALL ABYTT (A(M,J),A(M,J+1),A(M-1,J+1),A(M+1,J),A(M+2,J),A(M+1,J+1 SPECLN  291
                1) )                                                            SPECLN  292
                CALL ABYTT (A(M-3,J+3),A(M-3,J+4),A(M-4,J+4),A(M-2,J+3),A(M-1,J+3) SPECLN  293
                1 ,A(M-2,J+4) )                                                 SPECLN  294
                CALL ABYTT (A(M+3,J),A(M+3,J+1),A(M+2,J+1),A(M+4,J),A(M+5,J),   SPECLN  295
  295           1 A(M+4,J+1) )                                                  SPECLN  296
                CALL ABYTT (A(M,J+3),A(M,J+4),A(M-1,J+4),A(M+1,J+3),A(M+2,J+3),  SPECLN  297
                1 A(M+1,J+4) )                                                  SPECLN  298
                IF (MQ .NE. 0) GO TO 445                                        SPECLN  299
              410 N2=KMEK(LL)                                                   SPECLN  300
  300           IF (N2.EQ.0) GO TO 420                                          SPECLN  301
              C UNTRANSFORMED AREA                                              SPECLN  302
                MQ= 0                                                           SPECLN  303
              415 CALL TBYA (A(M,J),A(M,J+1),A(M-1,J+1),A(M+1,J),A(M-2,J+2),    SPECLN  304
                1 A(M-1,J+2) )                                                  SPECLN  305
  305           CALL TBYA (A(M-3,J+3),A(M-3,J+4),A(M-4,J+4),A(M-2,J+3), A(M-5,J+5 SPECLN  306
                1), A(M-4,J+5) )                                                SPECLN  307
                CALL TBYA (A(M+3,J),A(M+3,J+1),A(M+2,J+1),A(M+4,J),A(M+1,J+2),  SPECLN  308
                1 A(M+2,J+2) )                                                  SPECLN  309
                CALL TBYA (A(M,J+3),A(M,J+4),A(M-1,J+4),A(M+1 ,J+3),A(M-2,J+5),  SPECLN  310
  310           1 A(M-1,J+5) )                                                  SPECLN  311
                IF (MQ .NE. 0) GO TO 455                                        SPECLN  312
              420 A(M,J)= A(M,J) + A(MM,L)                                      SPECLN  313
                A(M,J+1)= A(M,J+1) + A(MM,L+1)                                  SPECLN  314
                A(M,J+2)= A(M,J+2) + A(MM,L+2)                                  SPECLN  315
  315           A(M,J+3)= A(M,J+3) + A(MM,L+3)                                  SPECLN  316
                A(M,J+4)= A(M,J+4) + A(MM,L+4)                                  SPECLN  317
                A(M,J+5) = A(M,J+5) + A(MM,L+5)                                 SPECLN  318
                A(M+1,J)= A(M+1,J) + A(MM+1,L)                                  SPECLN  319
                A(M+1,J+1)= A(M+1,J+1)+ A(MM+1,L+1)                             SPECLN  320
  320           A(M+1,J+2)= A(M+1,J+2)+ A(MM+1,L+2)                             SPECLN  321
                A(M+1,J+3)= A(M+1,J+3)+ A(MM+1,L+3)                             SPECLN  322
                A(M+1,J+4)= A(M+1,J+4)+ A(MM+1,L+4)                             SPECLN  323
                A(M+2,J)= A(M+2,J) + A(MM+2,L)                                  SPECLN  324
                A(M+2,J+1)= A(M+2,J+1) + A(MM+2,L+1)                            SPECLN  325
  325           A(M+2,J+2)= A(M+2,J+2) + A(MM+2,L+2)                            SPECLN  326
                A(M+2,J+3)= A(M+2,J+3) + A(MM+2,L+3)                            SPECLN  327
                A(M+3,J)= A(M+3,J) + A(MM+3,L)                                  SPECLN  328
                A(M+3,J+1)= A(M+3,J+1) + A(MM+3,L+1)                            SPECLN  329
                A(M+3,J+2)= A(M+3,J+2) + A(MM+3,L+2)                            SPECLN  330
  330           A(M+4,J)= A(M+4,J) +  A(MM+4,L)                                 SPECLN  331
                A(M+4,J+1)= A(M+4,J+1) +  A(MM+4,L+1)                           SPECLN  332
                A(M+5,J)=  A(M+5,J) + A(MM+5,L)                                 SPECLN  333
              C UPPER HALF                                                      SPECLN  334
                A(M-1,J+1)= A(M-1,J+1) + A(MM-1,L+1)                            SPECLN  335
  335           A(M-1,J+2)= A(M-1,J+2) + A(MM-1,L+2)                            SPECLN  336
                A(M-1,J+3)= A(M-1,J+3) + A(MM-1,L+3)                            SPECLN  337
                A(M-1,J+4)= A(M-1,J+4) + A(MM-1,L+4)                            SPECLN  338
                A(M-1,J+5)= A(M-1,J+5) + A(MM-1,L+5)                            SPECLN  339
                A(M-2,J+2)= A(M-2,J+2) + A(MM-2,L+2)                            SPECLN  340
  340           A(M-2,J+3)= A(M-2,J+3) + A(MM-2,L+3)                            SPECLN  341
                A(M-2,J+4)= A(M-2,J+4) + A(MM-2,L+4)                            SPECLN  342
                A(M-2,J+5)= A(M-2,J+5) + A(MM-2,L+5)                            SPECLN  343
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      A(M-3,J+3)= A(M-3,J+3) + A(MM-3,L+3)                              SPECLN  344
      A(M-3,J+4)= A(M-3,J+4) + A(MM-3,L+4)                              SPECLN  345
      A(M-3,J+5)= A(M-3,J+5) + A(MM-3,L+5)                              SPECLN  346
      A(M-4,J+4)= A(M-4,J+4) + A(MM-4,L+4)                              SPECLN  347
      A(M-4,J+5)= A(M-4,J+5) + A (MM-4,L+5)                             SPECLN  348
      A(M-5,J+5)= A(M-5,J+5) + A(MM-5,L+5)                              SPECLN  349
  440 IF (J.LT.NROW2) GO TO 460                                         SPECLN  350
      IF (N1.EQ.0) GO TO 450                                            SPECLN  351
      IF (N2.NE.0) N1=KHEK(N)                                           SPECLN  352
C     RESTORE AREA                                                      SPECLN  353
      SINT=-SINT                                                        SPECLN  354
      MQ= 1                                                             SPECLN  355
      GO TO 405                                                         SPECLN  356
  445 SINT= -SINT                                                       SPECLN  357
  450 IF (N2.EQ.0) GO TO 460                                            SPECLN  358
      IF (N1.NE.0) N2=KHEK(LL)                                          SPECLN  359
      SINT=-SINT                                                        SPECLN  360
      MQ= 1                                                             SPECLN  361
      GO TO 415                                                         SPECLN  362
  455 SINT= - SINT                                                      SPECLN  363
  460 CONTINUE                                                          SPECLN  364
C     FORCE VECTOR (CENTRIF + THERMAL ONLY)                             SPECLN  365
  470 IF (J.LT.NROW2) GO TO 480                                         SPECLN  366
      N1=KHEK(N)                                                        SPECLN  367
      IF (N1.EQ.0) GO TO 480                                            SPECLN  368
C     UNTRANFORMED                                                      SPECLN  369
      MQ= 0                                                             SPECLN  370
  475 DUM1= B(J)                                                        SPECLN  371
      DUM2=B(J+1)                                                       SPECLN  372
      B(J)=COST*DUM1+SINT*DUM2                                          SPECLN  373
      B(J+1)=COST*DUM2-SINT*DUM1                                        SPECLN  374
      DUM1= B(J+3)                                                      SPECLN  375
      DUM2= B(J+4)                                                      SPECLN  376
      B(J+3)= COST * DUM1 + SINT * DUM2                                 SPECLN  377
      B(J+4)= COST * DUM2 - SINT * DUM1                                 SPECLN  378
      IF (MQ .NE. 0) GO TO 485                                          SPECLN  379
  480 B(J)= B(J) + B(L)                                                 SPECLN  380
      B(J+1)= B(J+1) + B(L+1)                                           SPECLN  381
      B(J+2)= B(J+2) + B(L+2)                                           SPECLN  382
      B(J+3)= B(J+3) + B(L+3)                                           SPECLN  383
      B(J+4)= B(J+4) + B(L+4)                                           SPECLN  384
      B(J+5)= B(J+5) + B(L+5)                                           SPECLN  385
      IF (J.LT.NROW2) GO TO 490                                         SPECLN  386
      IF (N1.EQ.0) GO TO 490                                            SPECLN  387
C     RESTORE                                                           SPECLN  388
      SINT= -SINT                                                       SPECLN  389
      MQ= 1                                                             SPECLN  390
      GO TO 475                                                         SPECLN  391
  485 SINT= -SINT                                                       SPECLN  392
  490 CONTINUE                                                          SPECLN  393
  500 CONTINUE                                                          SPECLN  394
      RETURN                                                            SPECLN  395
      END                                                               SPECLN  396
```



0 0 5 2 0

```
                FUNCTION KHEK(N)                                        KHEK      2
                COMMON / SKEW / NSKEW, ISKEW(10), SINT, COST            KHEK      3
                KHEK= 0                                                 KHEK      4
                IF (NSKEW .EQ. 0) RETURN                                KHEK      5
                DO 10 I=1,NSKEW                                         KHEK      6
                IF ( N .EQ. ISKEW(I)) GO TO 20                          KHEK      7
             10 CONTINUE                                                KHEK      8
                RETURN                                                  KHEK      9
             20 KHEK= 1                                                 KHEK     10
                RETURN                                                  KHEK     11
                END                                                     KHEK     12
```

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      SUBROUTINE THYA (A11,A22,A12,A21,A13,A23)                          TBYA       2
C     INPLACE CALC. OF (T) * (A), (2X2) * (2X3)                          TBYA       3
      COMMON / SKEW / NSKEW, ISKEW(10), SINT, COST                       TBYA       4
      B11= COST * A11 + SINT * A21                                       TBYA       5
      B12= COST * A12 + SINT * A22                                       TBYA       6
      B13= COST * A13 + SINT * A23                                       TBYA       7
      B12= COST * A12 - SINT * A11                                       TBYA       8
      B22= COST * A22 - SINT * A12                                       TBYA       9
      B23= COST * A23 - SINT * A13                                       TBYA      10
   10 A11= B11                                                           TBYA      11
      A22= B22                                                           TBYA      12
      A12= B12                                                           TBYA      13
      A21= B21                                                           TBYA      14
      A13= B13                                                           TBYA      15
      A23= B23                                                           TBYA      16
      RETURN                                                             TBYA      17
C                                                                        TBYA      18
      ENTRY ABYTT                                                        TBYA      19
C     CALC. (A) * (T)TRANSPOSE, (3X2) * (2X2)                            TBYA      20
      B11= COST * A11 + SINT * A12                                       TBYA      21
      B21= COST * A21 + SINT * A22                                       TBYA      22
      B13= COST * A13 + SINT * A23                                       TBYA      23
      B12= COST * A12 - SINT * A11                                       TBYA      24
      B22= COST * A22 - SINT * A21                                       TBYA      25
      B23= COST * A23 - SINT * A13                                       TBYA      26
      GO TO 10                                                           TBYA      27
      END                                                                TBYA      28
```



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```
      SUBROUTINE RCALC1 (N)                                                  RCALC1     2
C                                                                            RCALC1     3
      COMMON NODES,NELEM,E(720),PR(720),TH(720),X(400,3),NB(720,3),NODIS     RCALC1     4
     1(400,6),BC(400,6),COMT(13),RPMX,RPMY,RPMZ,GAMMA,B(192),A(192,96)       RCALC1     5
      COMMON /ARRAYS/ R(3,3),FK(9,9),T(9,9),S(18,18),SL(18,18),V(9,9),PT     RCALC1     6
     1(18)                                                                   RCALC1     7
      N1=IABS(NB(N,1))                                                       RCALC1     8
      N2=NB(N,2)                                                             RCALC1     9
      N3=NB(N,3)                                                             RCALC1    10
      X1=X(N1,1)                                                             RCALC1    11
      Y1=X(N1,2)                                                             RCALC1    12
      Z1=X(N1,3)                                                             RCALC1    13
      X2=X(N2,1)                                                             RCALC1    14
      Y2=X(N2,2)                                                             RCALC1    15
      Z2=X(N2,3)                                                             RCALC1    16
      X3=X(N3,1)                                                             RCALC1    17
      Y3=X(N3,2)                                                             RCALC1    18
      Z3=X(N3,3)                                                             RCALC1    19
      X21=X2-X1                                                              RCALC1    20
      Y21=Y2-Y1                                                              RCALC1    21
      Z21=Z2-Z1                                                              RCALC1    22
      X31=X3-X1                                                              RCALC1    23
      Y31=Y3-Y1                                                              RCALC1    24
      Z31=Z3-Z1                                                              RCALC1    25
      TEMP=SQRT(X21**2+Y21**2+Z21**2)                                        RCALC1    26
      IF (TEMP.EQ.0.) GO TO 250                                              RCALC1    27
      R(1,1)=X21/TEMP                                                        RCALC1    28
      R(2,1)=Y21/TEMP                                                        RCALC1    29
      R(3,1)=Z21/TEMP                                                        RCALC1    30
      TEMPA=Y21*Z31-Y31*Z21                                                  RCALC1    31
      TEMPB=X31*Z21-X21*Z31                                                  RCALC1    32
      TEMPC=X21*Y31-X31*Y21                                                  RCALC1    33
      TEMP=SQRT(TEMPA**2+TEMPB**2+TEMPC**2)                                  RCALC1    34
      IF (TEMP.EQ.0.) GO TO 250                                              RCALC1    35
      R(1,3)=TEMPA/TEMP                                                      RCALC1    36
      R(2,3)=TEMPB/TEMP                                                      RCALC1    37
      R(3,3)=TEMPC/TEMP                                                      RCALC1    38
      R(1,2)=R(2,3)*R(3,1)-R(3,3)*R(2,1)                                     RCALC1    39
      R(2,2)=R(3,3)*R(1,1)-R(1,3)*R(3,1)                                     RCALC1    40
      R(3,2)=R(1,3)*R(2,1)-R(2,3)*R(1,1)                                     RCALC1    41
      RETURN                                                                 RCALC1    42
  250 WRITE (6,270) N                                                        RCALC1    43
  270 FORMAT (16H0BAD ELEMENT NO.I5,7H RCALC1   )                            RCALC1    44
      CALL EXIT                                                              RCALC1    45
      END                                                                    RCALC1    46
```



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```
      SUBROUTINE MODIFY (NEQ,N,U,A,B,KKK)                          MODIFY     2
      DIMENSION A(KKK,1),B(1)                                      MODIFY     3
      NROW2= NEQ / 2                                               MODIFY     4
      DO 20 M=2,KKK                                                MODIFY     5
      K=N-M+1                                                      MODIFY     6
      IF (K.LE.0) GO TO 10                                         MODIFY     7
      IF (K .GT. NROW2) GO TO 10                                   MODIFY     8
      B(K)= B(K) - A(M,K) * U                                      MODIFY     9
      A(M,K)= 0.                                                   MODIFY    10
   10 K=N+M-1                                                      MODIFY    11
      IF (K.GT.NEQ) GO TO 20                                       MODIFY    12
      IF (N .GT. NROW2) GO TO 20                                   MODIFY    13
      B(K)= B(K) - A(M,N) * U                                      MODIFY    14
      A(M,N)= 0.                                                   MODIFY    15
   20 CONTINUE                                                     MODIFY    16
      IF (N .GT. NROW2) RETURN                                     MODIFY    17
      A(1,N)= 1.0                                                  MODIFY    18
      B(N)=U                                                       MODIFY    19
      RETURN                                                       MODIFY    20
      END                                                          MODIFY    21
```

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```
1              SUBROUTINE MOVE (A,B,N)                                  MOVE    2
               DIMENSION A(9,9), B(18,18)                               MOVE    3
               DO 10 I=1,N                                              MOVE    4
               DO 10 J=1,N                                              MOVE    5
5           10 B(I,J)=A(I,J)                                            MOVE    6
               RETURN                                                   MOVE    7
               END                                                      MOVE    8
```

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```
      SUBROUTINE ABAT (A,B,C,E)                                          ABAT      2
      DIMENSION A(3,3), B(18,18), C(18,18), D(3,3),E(3,3)                ABAT      3
      DO 20 I=1,3                                                        ABAT      4
      DO 20 J=1,3                                                        ABAT      5
      SUM=0.                                                             ABAT      6
      DO 10 K=1,3                                                        ABAT      7
   10 SUM=SUM+A(I,K)*B(K,J)                                              ABAT      8
   20 D(I,J)=SUM                                                         ABAT      9
      DO 40 I=1,3                                                        ABAT     10
      DO 40 J=1,3                                                        ABAT     11
      SUM=0.                                                             ABAT     12
      DO 30 K=1,3                                                        ABAT     13
   30 SUM=SUM+D(I,K)*E(J,K)                                              ABAT     14
   40 C(I,J)=SUM                                                         ABAT     15
      RETURN                                                             ABAT     16
      END                                                                ABAT     17
```



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      SUBROUTINE TRIANG (N,TWODEL)                                          TRIANG     2
      COMMON /PARAM/ E,ETA,X1,Y1,Z1,X2,Y2,Z2,X3,Y3,Z3,TH                    TRIANG     3
      COMMON /ARRAYS/ R(3,3),FK(9,9),T(9,9),S(18,18),SL(18,18),V(9,9),PT    TRIANG     4
     1(18)                                                                  TRIANG     5
      COMMON /KGCALC/ KKPASS,SIGX(720),SIGY(720),TAUXY(720)                 TRIANG     6
      COMMON /THERML/ TMPT(720),TMPB(720),ALPHAT(720)                       TRIANG     7
      COMMON/SPECL/ KSPEC(400)                                              TRIANG     8
      COMMON / TRI / N1,N2,N3,P(18)                                         TRIANG     9
      DIMENSION PS(18)                                                      TRIANG    10
      DIMENSION H(9,6)                                                      TRIANG    11
      EQUIVALENCE (H,FK)                                                    TRIANG    12
      IF (TH.EQ.0.) GO TO 240                                               TRIANG    13
      BETA=(1.-ETA)*.5                                                      TRIANG    14
      D=E*TH**3/12./(1.-ETA**2)                                             TRIANG    15
C     ZERO LOCAL STIFFNESS MATRIX                                           TRIANG    16
      DO 10 I=1,324                                                         TRIANG    17
   10 SL(I)=0.                                                              TRIANG    18
C     CALC. ROTATION MATRIX R. (XG,YG,ZG)T = R* (XL,YL,ZL)T. R*(R)T= 1.     TRIANG    19
      X21=X2-X1                                                             TRIANG    20
      Y21=Y2-Y1                                                             TRIANG    21
      Z21=Z2-Z1                                                             TRIANG    22
      X31=X3-X1                                                             TRIANG    23
      Y31=Y3-Y1                                                             TRIANG    24
      Z31=Z3-Z1                                                             TRIANG    25
      TEMP=SQRT(X21**2+Y21**2+Z21**2)                                       TRIANG    26
      IF (TEMP.EQ.0.) GO TO 240                                             TRIANG    27
      R(1,1)=X21/TEMP                                                       TRIANG    28
      R(2,1)=Y21/TEMP                                                       TRIANG    29
      R(3,1)=Z21/TEMP                                                       TRIANG    30
      TEMPA=Y21*Z31-Y31*Z21                                                 TRIANG    31
      TEMPB=X31*Z21-X21*Z31                                                 TRIANG    32
      TEMPC=X21*Y31-X31*Y21                                                 TRIANG    33
      TEMP=SQRT(TEMPA**2+TEMPB**2+TEMPC**2)                                 TRIANG    34
      IF (TEMP.EQ.0.) GO TO 240                                             TRIANG    35
      R(1,3)=TEMPA/TEMP                                                     TRIANG    36
      R(2,3)=TEMPB/TEMP                                                     TRIANG    37
      R(3,3)=TEMPC/TEMP                                                     TRIANG    38
      R(1,2)=R(2,3)*R(3,1)-R(3,3)*R(2,1)                                    TRIANG    39
      R(2,2)=R(3,3)*R(1,1)-R(1,3)*R(3,1)                                    TRIANG    40
      R(3,2)=R(1,3)*R(2,1)-R(2,3)*R(1,1)                                    TRIANG    41
C     TRANSFORM COORDINATES TO LOCAL SYSTEM. SET A,B,C DIMENSIONS.          TRIANG    42
      X11=R(1,1)*X1+R(2,1)*Y1+R(3,1)*Z1                                     TRIANG    43
      X21=R(1,1)*X2+R(2,1)*Y2+R(3,1)*Z2                                     TRIANG    44
      X31=R(1,1)*X3+R(2,1)*Y3+R(3,1)*Z3                                     TRIANG    45
      A=X21-X31                                                             TRIANG    46
      B=X31-X11                                                             TRIANG    47
      Y11=R(1,2)*X1+R(2,2)*Y1+R(3,2)*Z1                                     TRIANG    48
      Y21=R(1,2)*X2+R(2,2)*Y2+R(3,2)*Z2                                     TRIANG    49
      Y31=R(1,2)*X3+R(2,2)*Y3+R(3,2)*Z3                                     TRIANG    50
      C=Y31-Y11                                                             TRIANG    51
C     TRANSLATE TO C.G. OF TRIANGLE TO CODE BENDING MATRIX                  TRIANG    52
      TEMP=(X11+X21+X31)/3.                                                 TRIANG    53
      X1=X11-TEMP                                                           TRIANG    54
      X2=X21-TEMP                                                           TRIANG    55
      X3=X31-TEMP                                                           TRIANG    56
      TEMP=(Y11+Y21+Y31)/3.                                                 TRIANG    57
      Y1=Y11-TEMP                                                           TRIANG    58
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      Y2=Y21-TEMP                                                       TRIANG  59
      Y3=Y31-TEMP                                                       TRIANG  60
   60 TWODEL=C*(A+B)                                                    TRIANG  61
      A1=TWODEL/3.                                                      TRIANG  62
C     FORM T. IGNORE CONSTANT FACTOR FOR NOW                            TRIANG  63
      DO 20 I=1,81                                                      TRIANG  64
   20 T(I)=0.                                                           TRIANG  65
   65 T(1,1)=A                                                          TRIANG  66
      T(3,1)=A                                                          TRIANG  67
      T(5,1)=A                                                          TRIANG  68
      T(2,1)=-C                                                         TRIANG  69
      T(4,1)=-C                                                         TRIANG  70
   70 T(6,1)=-C                                                         TRIANG  71
      T(1,2)=TWODEL                                                     TRIANG  72
      T(2,3)=TWODEL                                                     TRIANG  73
      T(3,5)=TWODEL                                                     TRIANG  74
      T(4,6)=TWODEL                                                     TRIANG  75
   75 T(5,8)=TWODEL                                                     TRIANG  76
      T(6,9)=TWODEL                                                     TRIANG  77
      T(1,4)=B                                                          TRIANG  78
      T(3,4)=B                                                          TRIANG  79
      T(5,4)=B                                                          TRIANG  80
   80 T(2,4)=C                                                          TRIANG  81
      T(4,4)=C                                                          TRIANG  82
      T(6,4)=C                                                          TRIANG  83
      T(1,7)=-(A+B)                                                     TRIANG  84
      T(3,7)=T(1,7)                                                     TRIANG  85
   85 T(5,7)=T(1,7)                                                     TRIANG  86
C     FORM H.                                                           TRIANG  87
      TEMP=A+B                                                          TRIANG  88
      CON1=-C**2                                                        TRIANG  89
      CON2=A*B-TEMP**2                                                  TRIANG  90
   90 CON5=-2.*C                                                        TRIANG  91
      CON6=-A-2.*B                                                      TRIANG  92
      CON7=-2.*A-B                                                      TRIANG  93
      CON8=B-A                                                          TRIANG  94
      CON9=2.*C**2                                                      TRIANG  95
   95 CON12=2.*A**2                                                     TRIANG  96
      CON13=2.*B**2                                                     TRIANG  97
      CON14=2.*TEMP**2                                                  TRIANG  98
      H(1,1)=A1*C**3                                                    TRIANG  99
      H(1,3)=H(1,1)                                                     TRIANG 100
  100 H(1,5)=2.*H(1,1)                                                  TRIANG 101
      H(4,2)=A1*CON6*(CON2+CON12)                                       TRIANG 102
      H(4,4)=A1*CON7*(CON2+CON13)                                       TRIANG 103
      H(4,6)=A1*CON8*(CON2+CON14)                                       TRIANG 104
      TEMPA=4.*A*TWODEL                                                 TRIANG 105
  105 TEMPB=4.*B*TWODEL                                                 TRIANG 106
      TEMPC=4.*C*TWODEL                                                 TRIANG 107
      TEMPD=4.*TEMP*TWODEL                                              TRIANG 108
      H(4,1)=A1*(C*(CON2+CON12)-TEMPA)                                  TRIANG 109
      H(4,3)=A1*(C*(CON2+CON13)-TEMPB)                                  TRIANG 110
  110 H(4,5)=A1*(CON5*(CON2+CON14)+TEMPD)                               TRIANG 111
      H(1,2)=A1*(-CON6*CON1+TEMPC)                                      TRIANG 112
      H(1,4)=A1*(-CON7*CON1-TEMPC)                                      TRIANG 113
      H(1,6)=A1*CON8*CON1                                               TRIANG 114
      CON2=3.*A*B*TEMP                                                  TRIANG 115
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      H(2,1)=0.                                                          TRIANG  116
      H(2,3)=0.                                                          TRIANG  117
      H(2,5)=0.                                                          TRIANG  118
      H(6,2)=CON2*CON6                                                   TRIANG  119
      H(6,4)=CON2*CON7                                                   TRIANG  120
      H(6,6)=CON2*CON8                                                   TRIANG  121
      H(2,2)=-3.*CON9*TWODEL                                             TRIANG  122
      H(2,4)=H(2,2)                                                      TRIANG  123
      H(2,6)=0.                                                          TRIANG  124
      H(6,1)=CON2*C+3.*CON12*TWODEL                                      TRIANG  125
      H(6,3)=CON2*C+3.*CON13*TWODEL                                      TRIANG  126
      H(6,5)=CON2*CON5+3.*CON14*TWODEL                                   TRIANG  127
      CON1=C*CON8                                                        TRIANG  128
      CON15=4.*A*C                                                       TRIANG  129
      CON16=-4.*B*C                                                      TRIANG  130
      CON18=CON15*TWODEL                                                 TRIANG  131
      CON19=CON16*TWODEL                                                 TRIANG  132
      H(7,2)=A1*(CON6*(CON1+CON15)+TEMPA)                                TRIANG  133
      H(7,4)=A1*(CON7*(CON1+CON16)+TEMPB)                                TRIANG  134
      H(7,6)=A1*(CON8*CON1-TEMPD)                                        TRIANG  135
      H(7,1)=A1*(C*(CON1+CON15)-TEMPC)                                   TRIANG  136
      H(7,3)=A1*(C*(CON1+CON16)+TEMPC)                                   TRIANG  137
      H(7,5)=A1*CON5*CON1                                                TRIANG  138
      CON1=CON1*TEMP                                                     TRIANG  139
      CON2=-C**2*TEMP                                                    TRIANG  140
      H(5,2)=CON6*CON1-CON12*TWODEL                                      TRIANG  141
      H(5,4)=CON7*CON1-CON13*TWODEL                                      TRIANG  142
      H(5,6)=CON8*CON1-CON14*TWODEL                                      TRIANG  143
      H(3,1)=C*CON2+CON9*TWODEL                                          TRIANG  144
      H(3,3)=H(3,1)                                                      TRIANG  145
      H(3,5)=CON5*CON2                                                   TRIANG  146
      H(5,1)=C*CON1+CON18                                                TRIANG  147
      H(5,3)=C*CON1+CON19                                                TRIANG  148
      H(5,5)=CON5*CON1                                                   TRIANG  149
      H(3,2)=CON6*CON2-CON18                                             TRIANG  150
      H(3,4)=CON7*CON2-CON19                                             TRIANG  151
      H(3,6)=CON8*CON2                                                   TRIANG  152
      L=3                                                                TRIANG  153
      DO 40 J=8,9                                                        TRIANG  154
      DO 30 I=1,6                                                        TRIANG  155
   30 H(J,I)=H(L,I)*2.                                                   TRIANG  156
   40 L=5                                                                TRIANG  157
C     CALC. H*T AND STORE IN S                                           TRIANG  158
      DO 60 I=1,9                                                        TRIANG  159
      DO 60 J=1,9                                                        TRIANG  160
      SUM=0.                                                             TRIANG  161
      DO 50 L=1,6                                                        TRIANG  162
   50 SUM=SUM+H(I,L)*T(L,J)                                              TRIANG  163
   60 S(I,J)=SUM                                                         TRIANG  164
C     FORM INTEGRAL V. INCLUDE ALL CONSTANT MULTIPLIERS                  TRIANG  165
      CON1=X1**2+X2**2+X3**2                                             TRIANG  166
      CON2=Y1**2+Y2**2+Y3**2                                             TRIANG  167
      CON3=X1*Y1+X2*Y2+X3*Y3                                             TRIANG  168
      DO 70 I=1,9                                                        TRIANG  169
      DO 70 J=1,9                                                        TRIANG  170
   70 V(I,J)=0.                                                          TRIANG  171
      V(1,1)=12.                                                         TRIANG  172
```

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      V(4,4)=V(1,1)                                                     TRIANG  173
      V(1,4)=V(1,1)*ETA                                                 TRIANG  174
      V(7,7)=V(1,1)*BETA                                                TRIANG  175
      V(2,2)=CON1                                                       TRIANG  176
      V(2,3)=CON3                                                       TRIANG  177
      V(2,5)=ETA*CON1                                                   TRIANG  178
      V(2,6)=ETA*CON3                                                   TRIANG  179
      V(3,5)=V(2,6)                                                     TRIANG  180
      V(3,3)=CON2                                                       TRIANG  181
      V(3,6)=ETA*CON2                                                   TRIANG  182
      V(5,5)=CON1                                                       TRIANG  183
      V(5,6)=CON3                                                       TRIANG  184
      V(6,6)=CON2                                                       TRIANG  185
      V(8,8)=BETA*CON1                                                  TRIANG  186
      V(8,9)=BETA*CON3                                                  TRIANG  187
      V(9,9)=BETA*CON2                                                  TRIANG  188
      CON1=D/24./TMODEL**7                                              TRIANG  189
      DO 80 I=1,9                                                       TRIANG  190
      DO 80 J=I,9                                                       TRIANG  191
      V(I,J)=V(I,J)*CON1                                                TRIANG  192
   80 V(J,I)=V(I,J)                                                     TRIANG  193
C     CALC. V * (H*T) AND STORE IN T                                    TRIANG  194
      DO 100 I=1,9                                                      TRIANG  195
      DO 100 J=1,9                                                      TRIANG  196
      SUM=0.                                                            TRIANG  197
      DO 90 L=1,9                                                       TRIANG  198
   90 SUM=SUM+V(I,L)*S(L,J)                                             TRIANG  199
  100 T(I,J)=SUM                                                        TRIANG  200
C     CALC. (H*T)T* (V*(H*T) ) AND STORE IN V                           TRIANG  201
      DO 120 I=1,9                                                      TRIANG  202
      DO 120 J=1,9                                                      TRIANG  203
      SUM=0.                                                            TRIANG  204
      DO 110 L=1,9                                                      TRIANG  205
  110 SUM=SUM+S(L,I)*T(L,J)                                             TRIANG  206
  120 V(I,J)=SUM                                                        TRIANG  207
C     THE 9X9 LOCAL BENDING STIFFNESS IS NOW IN V                       TRIANG  208
      IF (KKPASS.EQ.0) GO TO 140                                        TRIANG  209
C     ADD DIFFERENTIAL STIFFNESS                                        TRIANG  210
      TEMP=TMODEL*TH/18.                                                TRIANG  211
      TEMPA=SIGX(N)*TEMP                                                TRIANG  212
      TEMPB=SIGY(N)*TEMP                                                TRIANG  213
      TEMPC=-TAUXY(N)*TEMP                                              TRIANG  214
      DO 130 I=2,8,3                                                    TRIANG  215
      K=I+1                                                             TRIANG  216
      DO 130 J=2,8,3                                                    TRIANG  217
      L=J+1                                                             TRIANG  218
      V(I,J)=V(I,J)+TEMPB                                               TRIANG  219
      V(I,L)=V(I,L)+TEMPC                                               TRIANG  220
      V(K,J)=V(K,J)+TEMPC                                               TRIANG  221
  130 V(K,L)=V(K,L)+TEMPA                                               TRIANG  222
C     MOVE V TO SL IN PROPER POSITIONS                                  TRIANG  223
  140 K=3                                                               TRIANG  224
      DO 160 I=1,7,3                                                    TRIANG  225
      L=3                                                               TRIANG  226
      DO 150 J=1,7,3                                                    TRIANG  227
      CALL MOVE (V(I,J),SL(K,L),3)                                      TRIANG  228
  150 L=L+6                                                             TRIANG  229
```



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```
  160 K=K+6                                                          TRIANG  230
C     PLATE BENDING EQUIVALENT THERMAL FORCES                        TRIANG  231
      TEMP=(TMPB(N)-TMPT(N))*ALPHAT(N)/TH                            TRIANG  232
      PI(4)=TEMP*.5*(A+B)**2                                         TRIANG  233
      PI(5)=0.                                                       TRIANG  234
      PI(6)=-TEMP*(A+B)                                              TRIANG  235
      PI(7)=TEMP*.5*(B**2+C**2)                                      TRIANG  236
      PI(8)=TEMP*C                                                   TRIANG  237
      PI(9)=-TEMP*B                                                  TRIANG  238
      K=2                                                            TRIANG  239
      DO 180 I=1,9                                                   TRIANG  240
      SUM=0.                                                         TRIANG  241
      DO 170 J=4,9                                                   TRIANG  242
  170 SUM=SUM+V(I,J)*PI(J)                                           TRIANG  243
      IF (I.EQ.4) K=5                                                TRIANG  244
      IF (I.EQ.7) K=8                                                TRIANG  245
  180 PS(I,K)=SUM                                                    TRIANG  246
C     FORM INPLANE STIFFNESS MATRIX                                  TRIANG  247
      TEMP=A+B                                                       TRIANG  248
      TEMPA=A**2                                                     TRIANG  249
      TEMPB=B**2                                                     TRIANG  250
      TEMPC=C**2                                                     TRIANG  251
      X21=A*C                                                        TRIANG  252
      Y21=A*B                                                        TRIANG  253
      Z21=B*C                                                        TRIANG  254
      X31=A*TEMP                                                     TRIANG  255
      Y31=B*TEMP                                                     TRIANG  256
      Z31=C*TEMP                                                     TRIANG  257
      FK(1,1)=TEMPC+BETA*TEMPA                                       TRIANG  258
      FK(1,2)=(ETA+BETA)*X21                                         TRIANG  259
      FK(1,3)=-TEMPC+BETA*Y21                                        TRIANG  260
      FK(1,4)=ETA*Z21-BETA*X21                                       TRIANG  261
      FK(1,5)=-BETA*X31                                              TRIANG  262
      FK(1,6)=-ETA*Z31                                               TRIANG  263
      FK(2,2)=TEMPA+BETA*TEMPC                                       TRIANG  264
      FK(2,3)=-ETA*X21+BETA*Z21                                      TRIANG  265
      FK(2,4)=Y21-BETA*TEMPC                                         TRIANG  266
      FK(2,5)=-BETA*Z31                                              TRIANG  267
      FK(2,6)=-X31                                                   TRIANG  268
      FK(3,3)=TEMPC+BETA*TEMPB                                       TRIANG  269
      FK(3,4)=-(ETA+BETA)*Z21                                        TRIANG  270
      FK(3,5)=-BETA*Y31                                              TRIANG  271
      FK(3,6)=ETA*Z31                                                TRIANG  272
      FK(4,4)=TEMPB+BETA*TEMPC                                       TRIANG  273
      FK(4,5)=BETA*Z31                                               TRIANG  274
      FK(4,6)=-Y31                                                   TRIANG  275
      FK(5,5)=BETA*TEMP**2                                           TRIANG  276
      FK(5,6)=0.                                                     TRIANG  277
      FK(6,6)=TEMP**2                                                TRIANG  278
      TEMP=6.*D/Z31/TH**2                                            TRIANG  279
      DO 190 I=1,6                                                   TRIANG  280
      DO 190 J=1,6                                                   TRIANG  281
      FK(I,J)=FK(I,J)*TEMP                                           TRIANG  282
  190 FK(J,I)=FK(I,J)                                                TRIANG  283
C     THE 6X6 LOCAL ELEMENT INPLANE STIFFNESS MATRIX IS NOW IN FK    TRIANG  284
C     MOVE FK TO S IN PROPER POSITIONS                               TRIANG  285
      K=1                                                            TRIANG  286
```



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```
                      DO 210 I=1,5,2                                                    TRIANG   287
                      L=1                                                               TRIANG   288
                      DO 200 J=1,5,2                                                    TRIANG   289
                      CALL MOVE (FK(I,J),SL(K,L),2)                                     TRIANG   290
290             200   L=L+6                                                             TRIANG   291
                210   K=K+6                                                             TRIANG   292
                C     INPLANE EQUIVALENT THERMAL FORCES                                 TRIANG   293
                      TEMP=6.*(1.+ETA)*D*((TMPT(N)+TMPB(N))*.5-70.)*ALPHAT(N)/TH**2     TRIANG   294
                      PS(1)=-C*TEMP                                                     TRIANG   295
295                   PS(2)=-A*TEMP                                                     TRIANG   296
                      PS(7)=-PS(1)                                                      TRIANG   297
                      PS(8)=-B*TEMP                                                     TRIANG   298
                      PS(13)=0.                                                         TRIANG   299
                      PS(14)=(A+B)*TEMP                                                 TRIANG   300
300                   PS(6)=0.                                                          TRIANG   301
                      PS(12)=0.                                                         TRIANG   302
                      PS(18)=0.                                                         TRIANG   303
                C     PLATE HAS NO INPLANE ROTATIONAL STIFFNESS -- PROVIDE A LITTLE     TRIANG   304
                C     BAR BETWEEN NODES 1 AND 2                                         TRIANG   305
305                   DIAM2= TH**2 / 100.                                               TRIANG   306
                      ALP= 16. / DIAM2                                                  TRIANG   307
                      FINERT= 3.1416 * DIAM2**2 / 64.                                   TRIANG   308
                      FLEN= A + B                                                       TRIANG   309
                      CALL MEMSET (S, S(18,18), 0.)                                     TRIANG   310
310                   S(1,1)= ALP / FLEN                                                TRIANG   311
                      S(2,6)= 6. / FLEN**2                                              TRIANG   312
                      S(2,2)= S(2,6) * 2. / FLEN                                        TRIANG   313
                      S(6,6)= 4. / FLEN                                                 TRIANG   314
                      S(1,7)= - S(1,1)                                                  TRIANG   315
315                   S(2,8)= - S(2,2)                                                  TRIANG   316
                      S(2,12)= - S(2,6)                                                 TRIANG   317
                      S(6,8)= S(2,12)                                                   TRIANG   318
                      S(6,12)= S(6,6) * .5                                              TRIANG   319
                      S(7,7)= S(1,1)                                                    TRIANG   320
320                   S(8,8)= S(2,2)                                                    TRIANG   321
                      S(8,12)= S(2,6)                                                   TRIANG   322
                      S(12,12)= S(6,6)                                                  TRIANG   323
                C     ADD IN BAR BETWEEN NODES 2 AND 3                                  TRIANG   324
                      FLEN= SQRT(A**2 + C**2)                                           TRIANG   325
325                   SINT= C / FLEN                                                    TRIANG   326
                      COST= - A / FLEN                                                  TRIANG   327
                      CON11= ALP / FLEN                                                 TRIANG   328
                      CON26= 6. / FLEN**2                                               TRIANG   329
                      CON22= CON26 * 2. / FLEN                                          TRIANG   330
330                   CON66= 4. / FLEN                                                  TRIANG   331
                      S(13,13)= CON11 * COST**2 + CON22 * SINT**2                       TRIANG   332
                      S(13,18)= - CON26 * SINT                                          TRIANG   333
                      S(14,18)=  CON26 * COST                                           TRIANG   334
                      S(14,14)= CON11 * SINT**2 + CON22 * COST**2                       TRIANG   335
335                   S(13,14)= (CON11 - CON22) * SINT * COST                           TRIANG   336
                      S(18,18)= CON66                                                   TRIANG   337
                      S(7,7)= S(7,7) + S(13,13)                                         TRIANG   338
                      S(7,8)= S(13,14)                                                  TRIANG   339
                      S(7,12)= S(13,18)                                                 TRIANG   340
340                   S(8,12)= S(8,12) + S(14,18)                                       TRIANG   341
                      S(8,8)= S(8,8) + S(14,14)                                         TRIANG   342
                      S(12,12)= S(12,12) + S(18,18)                                     TRIANG   343
```



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```
                S(7,13)= -S(13,13)                                                  TRIANG  344
                S(7,14)= - S(13,14)                                                 TRIANG  345
      345       S(7,18)= - S(13,18)                                                 TRIANG  346
                S(8,14)= - S(14,14)                                                 TRIANG  347
                S(8,13)= S(7,14)                                                    TRIANG  348
                S(8,18)= - S(14,18)                                                 TRIANG  349
                S(12,14)= S(8,18)                                                   TRIANG  350
      350       S(12,13)= S(7,18)                                                   TRIANG  351
                S(12,18)= S(18,18) * .5                                             TRIANG  352
            C   ADD IN BAR BETWEEN NODES 1 AND 3                                    TRIANG  353
                FLEN= SQRT (B**2 + C**2)                                            TRIANG  354
                SINT= C / FLEN                                                      TRIANG  355
      355       COST= B / FLEN                                                      TRIANG  356
                CON11= ALP / FLEN                                                   TRIANG  357
                CON26= 6. / FLEN**2                                                 TRIANG  358
                CON22= CON26 * 2. / FLEN                                            TRIANG  359
                CON66= 4. / FLEN                                                    TRIANG  360
      360       CON612= CON66 * .5                                                  TRIANG  361
                SUM= CON11                                                          TRIANG  362
                CON12= (CON11 - CON22) * SINT * COST                                TRIANG  363
                CON11= CON11 * COST**2 + CON22 * SINT **2                           TRIANG  364
                CON22= SUM * SINT**2 + CON22 * COST **2                             TRIANG  365
      365       CON16= - CON26 * SINT                                               TRIANG  366
                CON26= CON26 * COST                                                 TRIANG  367
                S(1,1)= S(1,1) + CON11                                              TRIANG  368
                S(1,2)= CON12                                                       TRIANG  369
                S(1,6)= CON16                                                       TRIANG  370
      370       S(2,2)= S(2,2) + CON22                                              TRIANG  371
                S(2,6)= S(2,6) + CON26                                              TRIANG  372
                S(6,6)= S(6,6) + CON66                                              TRIANG  373
                S(1,13)= - CON11                                                    TRIANG  374
                S(1,14)= - CON12                                                    TRIANG  375
      375       S(1,18)= - CON16                                                    TRIANG  376
                S(2,13)= S(1,14)                                                    TRIANG  377
                S(2,14)= -CON22                                                     TRIANG  378
                S(2,18)= -CON26                                                     TRIANG  379
                S(6,13)= S(1,18)                                                    TRIANG  380
      380       S(6,14)= S(2,18)                                                    TRIANG  381
                S(6,18)= CON612                                                     TRIANG  382
                S(13,13)= S(13,13) + CON11                                          TRIANG  383
                S(13,14)= S(13,14) + CON12                                          TRIANG  384
                S(14,14)= S(14,14) + CON22                                          TRIANG  385
      385       S(13,18)= CON16 + S(13,18)                                          TRIANG  386
                S(14,18)= CON26 + S(14,18)                                          TRIANG  387
                S(18,18)= S(18,18) + CON66                                          TRIANG  388
                CON11= E * FINERT                                                   TRIANG  389
                DO 400 I=1,18                                                       TRIANG  390
      390       DO 395 J=1,18                                                       TRIANG  391
                S(I,J)= S(I,J) * CON11                                              TRIANG  392
                SL(I,J)= SL(I,J) + S(I,J)                                           TRIANG  393
           395  SL(J,1)= SL(I,J)                                                    TRIANG  394
           400  CONTINUE                                                            TRIANG  395
      395       C     LOCAL ELEMENT STIFFNESS MATRIX IS READY FOR TRANS. TO GLOBAL SYSTE TRIANG  396
                C     TRANSFORM THERMAL FORCE VECTOR TO GLOBAL SYSTEM               TRIANG  397
                      DO 220 I=1,16,3                                               TRIANG  398
                212   CALL ABC (R,PS(I),PT(I) )                                     TRIANG  399
                213   DO 220 J=1,16,3                                               TRIANG  400
```



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```
                      CALL ABAT (R,SL(I,J),S(I,J),R)                    TRIANG  401
                  220 CONTINUE                                          TRIANG  402
                      DO 230 I=1,18                                     TRIANG  403
                      DO 230 J=1,18                                     TRIANG  404
                  230 S(J,I)=S(I,J)                                     TRIANG  405
                      RETURN                                            TRIANG  406
                  240 WRITE (6,250) N                                   TRIANG  407
                      CALL EXIT                                         TRIANG  408
                C                                                       TRIANG  409
                  250 FORMAT (16H0BAD ELEMENT NO.I5)                    TRIANG  410
                      END                                               TRIANG  411
```

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```
1                SUBROUTINE ATBC (A,B)                                  ATBC     2
                 DIMENSION A(3,3),B(18),D(3)                            ATBC     3
                 DO 20 I=1,3                                            ATBC     4
                 SUM=0.                                                 ATBC     5
5                DO 10 J=1,3                                            ATBC     6
              10 SUM= SUM + A(J,I) * B(J)                               ATBC     7
              20 D(I) = SUM                                             ATBC     8
                 DO 30 I=1,3                                            ATBC     9
              30 B(I)= D(I)                                             ATBC    10
10               RETURN                                                 ATBC    11
                 END                                                    ATBC    12
```

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```
1                SUBROUTINE ABC (A,B,C)
                 DIMENSION A(3,3), B(1), C(1)
                 DO 20 I=1,3
                 SUM=0.
5                DO 10 J=1,3
              10 SUM=SUM+A(I,J)*B(J)
              20 C(I)=SUM
                 RETURN
                 END
```

```
ABC       2
ABC       3
ABC       4
ABC       5
ABC       6
ABC       7
ABC       8
ABC       9
ABC      10
```

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```
      OVERLAY ( FILED, 3, 4 )                                                    MAIN4      2
      PROGRAM MAIN4                                                              MAIN4      3
      COMMON NODES,NELEM,E(720),PR(720),TH(720),X(400,3),NB(720,3),NODIS         MAIN4      4
     1(400,6),BC(400,6),COMT(13),RPMX,RPMY,RPMZ,GAMMA,B(192),A(192,96)           MAIN4      5
      COMMON/LOGIC/ NROWS,NCOLM,NW,NUMBLK,NROW2                                  MAIN4      6
      COMMON/SPECL/ KSPEC(400)                                                   MAIN4      7
      COMMON /KGCALC/ KKPASS,SIGX(720),SIGY(720),TAUXY(720)                      MAIN4      8
      COMMON / SKEW / NSKEW, ISKEW(10), SINI, COST                               MAIN4      9
      DIMENSION SPACE(1)                                                         MAIN4     10
      EQUIVALENCE (SPACE,B)                                                      MAIN4     11
      DIMENSION FLAG(2)                                                          MAIN4     12
      DATA FLAG / 1H ,10H**LOCAL**      /                                        MAIN4     13
      CALL BANSOL (A,H,NCOLM,NROW2,1,400,NUMBLK,4,13,3)                          MAIN4     14
C     PRINT DEFLECTIONS                                                          MAIN4     15
      J=1                                                                        MAIN4     16
      KOUNT=0                                                                    MAIN4     17
      DO 180 I=1,NODES                                                           MAIN4     18
      IF (KKPASS .EQ. 0) GO TO 170                                               MAIN4     19
      KOUNT=KOUNT+1                                                              MAIN4     20
      IF (KOUNT.NE.1) GO TO 170                                                  MAIN4     21
      WRITE (6,210) COMT                                                         MAIN4     22
      WRITE (6,220)                                                              MAIN4     23
  170 K=J+5                                                                      MAIN4     24
      M=1                                                                        MAIN4     25
      IF (KSPEC(I) .NE. 0) M=2                                                   MAIN4     26
      IF (NSKEW .EQ. 0) GO TO 30                                                 MAIN4     27
      DO 20 L=1,NSKEW                                                            MAIN4     28
      IF ( I .NE. ISKEW(L)) GO TO 20                                             MAIN4     29
      DUM1= SPACE(J)                                                             MAIN4     30
      DUM2= SPACE(J+1)                                                           MAIN4     31
      SPACE(J)= COST * DUM1 - SINT * DUM2                                        MAIN4     32
      SPACE(J+1)= COST * DUM2 + SINT * DUM1                                      MAIN4     33
      DUM1= SPACE(J+3)                                                           MAIN4     34
      DUM2= SPACE(J+4)                                                           MAIN4     35
      SPACE(J+3)= COST * DUM1 - SINT * DUM2                                      MAIN4     36
      SPACE(J+4)= COST * DUM2 + SINT * DUM1                                      MAIN4     37
      GO TO 30                                                                   MAIN4     38
   20 CONTINUE                                                                   MAIN4     39
   30 CONTINUE                                                                   MAIN4     40
      IF (KKPASS .EQ. 0) GO TO 180                                               MAIN4     41
      WRITE (6,230) I,(SPACE(L),L=J,K),FLAG(M)                                   MAIN4     42
      IF (M .EQ. 2) WRITE(6,250) KSPEC(I)                                        MAIN4     43
      IF (KOUNT.GT.49) KOUNT=0                                                   MAIN4     44
  180 J=J+6                                                                      MAIN4     45
      WRITE (6,240) FLAG(2)                                                      MAIN4     46
  190 CONTINUE                                                                   MAIN4     47
  210 FORMAT (1H1,13A6)                                                          MAIN4     48
  220 FORMAT (50H0GLOBAL DEFLECTIONS (IN) AND ROTATIONS (RADIANS)--/6H0           MAIN4     49
     1NODE,7X,2HUX,13X,2HUY,13X,2HUZ,13X,7HTHETA X,8X,7HTHETA Y,8X,7HTHE         MAIN4     50
     2TA Z)                                                                      MAIN4     51
  230 FORMAT ( 1X, I5, F14.8, 5F15.8, 5X, A10 )                                  MAIN4     52
  240 FORMAT (50H0LOCAL COORDINATES OF ELEMENT N FOR NODES MARKED                 MAIN4     53
     1 ,A10,2H N / 1X,30HSEE LATER PRINT-OUT FOR GLOBAL  )                       MAIN4     54
  250 FORMAT (1H+,110X,I4)                                                       MAIN4     55
      END                                                                        MAIN4     56
```

BANSOL
STORAGE ALLOCATION.

| ADDRESS | LENGTH |
|---|---|
| 0 | 366 |
| 366 | |

BINARY CONTROL CARDS. 1

```
IDENT       BANSOL                                          3
END                                                         4
```

ENTRY POINTS. 7

BANSOL 104* 9

EXTERNAL SYMBOLS. 12

DISKIO 14

NOTE: This is a Compass routine. It is available in Fortran, but Fortran version was not used in program development.



```
                                IDENT   BANSOL                                                  BANSOL     2   1
                              **                                                                BANSOL     3   2
                              ** WRITTEN BY M. TANI, 93-383M                                    BANSOL     4   3
                              ** THIS ROUTINE IS AVAILABLE IN FORTRAN                           BANSOL     5   4
                              **                                                                BANSOL     6   5
                              ** SUBROUTINE BANSOL(A,B,NCOLM,NROW2,NVECT,NSOLBLK,NUMBLK,LUS,LUL,LUQ)  BANSOL     7   6
                              *     BANDED SYMMETRIC BLOCKED MATRIX SOLUTION ROUTINE            BANSOL     8   7
                              *     A IS A WORKING AREA TO CONTAIN TWO MATRIX BLOCKS            BANSOL     9   8
                              *     A MUST BE AT LEAST 2 * NCOLM * NROW2 IN LENGTH              BANSOL    10   9
                              *     B IS A WORKING AREA TO CONTAIN TWO VECTOR BLOCKS            BANSOL    11  10
                              *     B MUST BE AT LEAST 2 * NVECT * NROW2 IN LENGTH, PROVIDED THAT  BANSOL    12  11
                              *           A FOLLOWS B IN CORE. IF NOT, B MUST BE ALSO BE AT LEAST  BANSOL    13  12
                              *           NSOLBLK * NVECT IN LENGTH                             BANSOL    14  13
                              *     NCOLM IS THE HALF-BAND WIDTH OF THE SYMMETRIC BANDED MATRIX,  BANSOL    15  14
                              *           HOWEVER, NCOLM MAY BE INCREASED TO SATISFY THE RESTRICTION  BANSOL    16  15
                              *           BELOW                                                 BANSOL    17  16
                              *     NROW2 IS THE NUMBER OF ROWS OF THE SYMMETRIC BANDED MATRIX IN EACH  BANSOL    18  17
                              *           BLOCK                                                 BANSOL    19  18
                              *     NROW2 .GE. NCOLM                                            BANSOL    20  19
                              *     EACH BLOCK OF THE MATRIX IS ON LOGICAL UNIT LUS (DISK), AND   BANSOL    21  20
                              *           CONSISTS OF EXACTLY NCOLM * NROW2 WORDS. THE ORDER IS THAT  BANSOL    22  21
                              *           OF AN ARRAY DIMENSIONED (NCOLM,NROW2) WRITTEN IN ITS  BANSOL    23  22
                              *           NATURAL COMPUTER-STORED ORDER (COLUMNWISE).           BANSOL    24  23
                              *     NVECT IS THE NUMBER OF VECTORS TO BE SOLVED AGAINST A       BANSOL    25  24
                              *     EACH BLOCK OF THE VECTOR MATRIX IS ON LOGICAL UNIT LUL (DISK), AND  BANSOL    26  25
                              *           CONSISTS OF EXACTLY NVECT * NROW2 WORDS. THE ORDER IS THAT  BANSOL    27  26
                              *           OF AN ARRAY DIMENSIONED (NVECT,NROW2) WRITTEN IN ITS  BANSOL    28  27
                              *           NATURAL COMPUTER-STORED ORDER (COLUMNWISE).           BANSOL    29  28
                              *     NSOLBLK IS A NUMBER LARGE ENOUGH TO CONTAIN ONE COMPLETE SOLUTION  BANSOL    30  29
                              *           VECTOR.  HOWEVER, NSOLBLK MUST BE AT LEAST NUMBLK * NROW2  BANSOL    31  30
                              *     SOLUTION VECTOR I WILL BE LEFT STARTING AT B( 1 + (I-1)*NSOLBLK ),  BANSOL    32  31
                              *           I=1,2,3, ... , NVECT                                  BANSOL    33  32
                              *     IF A DOES NOT FOLLOW B IN CORE, SEE RESTRICTION ABOVE       BANSOL    34  33
                              *     IF A FOLLOWS B, NSOLBLK * NVECT MAY NOT EXCEED THE LENGTH OF B  BANSOL    35  34
                              *           PLUS NCOLM * NROW2                                    BANSOL    36  35
                              *     NUMBLK IS THE NUMBER OF MATRIX BLOCKS ON LUS AND LUL        BANSOL    37  36
                              *     NUMBLK * NVECT .LE. NCOLM                                   BANSOL    38  37
                              *     LUQ IS A SCRATCH LOGICAL UNIT (DISK).                       BANSOL    39  38
                              *     UNUSED PORTIONS OF ANY BLOCK MUST BE ZERO FILLED            BANSOL    40  39
                              **                                                                BANSOL    41  40
                              **                                                                BANSOL    42  41
000000 000001                 SAVEA0  BSS     1                                                 BANSOL    43  42
000001 000001                 CLTA    BSS     1                                                 BANSOL    44  43
000002 172040000000000000000  FONE    DATA    1.0                                               BANSOL    45  44
000003 000001                 NCOLM   BSS     1                                                 BANSOL    46  45
000004 000001                 NROW2   BSS     1                                                 BANSOL    47  46
000005 000001                 NVECT   BSS     1                                                 BANSOL    48  47
000006 000001                 NSOLBLK BSS     1                                                 BANSOL    49  48
000007 000001                 NUMBLK  BSS     1                                                 BANSOL    50  49
000010 000001                 QA(2,NN BSS     1       ADDR A(2,NROW2)                           BANSOL    51  50
000011 000001                 QB(1,NN BSS     1       ADDR B(1,NROW2)                           BANSOL    52  51
000012 000001                 QA(1,2) BSS     1       ADDR A(1,2*NROW2) - 1 = ADDR A(NCOLM      BANSOL    53  52
000013 000001                 NCOLMM1 BSS     1                                                 BANSOL    54  53
000014 000001                 LENGTH  BSS     1                                                 BANSOL    55  54
000015 000001                 LENGTHB BSS     1                                                 BANSOL    56  55
000016 000001                 QA(1,1) BSS     1       ADDR A(1,1)                               BANSOL    57  56
000017 000001                 QB(1,1) BSS     1       ADDR B(1,1)                               BANSOL    58  57
```

```
                                A(ISTAR   BSS     0          ADDR (A(1,NROW2+1)                  BANSOL  59  1
                          1     QA(1,P)   BSS     1          =                                   BANSOL  60  2
                                B(ISTAR   BSS     0          ADDR B(1,NROW2+1)                   BANSOL  61  3
                          1     QB(1,P)   BSS     1          =                                   BANSOL  62  4
                          1     A(IEND)   BSS     1          ADDR A(NCOLM,2*NROW2)               BANSOL  63  5
                          1     A(LENGT   BSS     1          ADDR A(NCOLM,  NROW2)               BANSOL  64  6
                          1     B(LENGT   BSS     1          ADDR B(NVECT,NROW2)                 BANSOL  65  7
                          1     B(IENDB   BSS     1          ADDR B(NVECT,2*NROW2)               BANSOL  66  8
 000000000000000001       ONE       DATA    1                                                    BANSOL  67  9
 000000000000000002       TWO       DATA    2                                                    BANSOL  68  10
 000000000000000000       ZERO      DATA    0                                                    BANSOL  69  11
 777777777777777776       MONE      DATA    -1                                                   BANSOL  70  12
                          3     CALL.1    BSS     3          DISKIO CALLING LIST AREAS           BANSOL  71  13
 000000000000000026 +             VFD     60/ONE     READ A                                      BANSOL  72  14
 000000000000000000               DATA    0                                                    BANSOL  73  15
                          3     CALL.2    BSS     3                                           BANSOL  74  16
 000000000000000026 +             VFD     60/ONE     READ B                                      BANSOL  75  17
 000000000000000000               DATA    0                                                    BANSOL  76  18
                          3     CALL.3    BSS     3                                           BANSOL  77  19
 000000000000000030 +             VFD     60/ZERO    WRITE B                                     BANSOL  78  20
 000000000000000000               DATA    0                                                    BANSOL  79  21
                          3     CALL.4    BSS     3                                           BANSOL  80  22
 000000000000000030 +             VFD     60/ZERO    WRITE A                                     BANSOL  81  23
 000000000000000000               DATA    0                                                    BANSOL  82  24
                          3     CALL.5    BSS     3                                           BANSOL  83  25
 000000000000000031 +             VFD     60/MONE    BACKSPACE                                   BANSOL  84  26
 000000000000000000               DATA    0                                                    BANSOL  85  27
                          3     CALL.6    BSS     3                                           BANSOL  86  28
 000000000000000027 +             VFD     60/TWO     REWIND                                      BANSOL  87  29
 000000000000000000               DATA    0                                                    BANSOL  88  30
                          1     QA(1,N)   BSS     1                                           BANSOL  89  31
                          1     QB(1,N)   BSS     1                                           BANSOL  90  32
                          1     QA(L,N)   BSS     1                                           BANSOL  91  33
                          1     PIVOT     BSS     1                                           BANSOL  92  34
                          1     XF.130    BSS     1                                           BANSOL  93  35
                          1     QA(1,I)   BSS     1                                           BANSOL  94  36
                          1     QB(1,I)   BSS     1                                           BANSOL  95  37
                          1     QA(2,N)   BSS     1                                           BANSOL  96  38
                          1     QB(1,L)   BSS     1                                           BANSOL  97  39
                          1     QA(NBB,   BSS     1                                           BANSOL  98  40
                          1     NBB       BSS     1                                           BANSOL  99  41
                          1     XIF.110   BSS     1                                           BANSOL  100 42
                                          EXT     DISKIO                                      BANSOL  101 43
                                ** ** ** ** ** ** ** ** ** ** ** ** ** ** ** ** ** ***       BANSOL  102 44
                                          ENTRY   BANSOL                                      BANSOL  103 45
                          1     BANSOL    BSS     1                                           BANSOL  104 46
                                ** ** ** ** ** ** ** ** ** ** ** ** ** ** ** ** ** ***       BANSOL  105 47
 74600                            SX6     A0         PICK UP A0                                  BANSOL  106 48
       74710                      SX7     A1         PICK UP A1                                  BANSOL  107 49
             5160000000 +         SA6     SAVEA0     SAVE CONTENTS OF A0                         BANSOL  108 50
 5170000001 +                     SA7     CLTA       SAVE CALLING LIST TRANSFER ADDRESS          BANSOL  109 51
             6140000001           SB4     1          B4=1                                        BANSOL  110 52
 54010                            SA0     A1         A0= TRANSFER ADDR                           BANSOL  111 53
       66644                      SB6     B4+B4      B6= 2                                       BANSOL  112 54
             64106                SB1     A0+B6      B1= ADDR WHERE ADDR OF NCOLM IS (F.P        BANSOL  113 55
                   46000          NO                                                             BANSOL  114 56
 6120000003 +                     SB2     NCOLM      B2= LOCAL PROGRAM ADDR                      BANSOL  115 57
```

```
                    6172000005          SB7     B2+5                                                    BANSOL  116  1
                                ** LOOP 1 PICKS UP VALUES OF NCOLM, NROW2, NVECT, NCOLBLK, NUMBLK    BANSOL  117  2
                                ** AND STORES LOCALLY                                                BANSOL  118  3
111 56110                       LOOP1   SA1     B1      X1= ADDRESS OF PARAMETER                     BANSOL  119  4
          53210                         SA2     X1      X2= VALUE OF PARAMETER                       BANSOL  120  5
               10622                    BX6     X2                                                   BANSOL  121  6
                    56620               SA6     B2      STORE LOCALLY                                BANSOL  122  7
112 66114                               SB1     B1+B4                                                BANSOL  123  8
          66224                         SB2     B2+B4                                                BANSOL  124  9
               0727000111 +             GT      B7,B2,LOOP1                                          BANSOL  125  10
                                ** END OF LOOP1                                                      BANSOL  126  11
                                ** SET UP ADDRESSES FOR PROGRAM                                      BANSOL  127  12
113 56410                               SA4     B1      X4= ADDR OF LUS                              BANSOL  128  13
          54544                         SA5     A4+B4   X5= ADDR OF LUL                              BANSOL  129  14
               10744                    BX7     X4                                                   BANSOL  130  15
                    10655               BX6     X5                                                   BANSOL  131  16
114 5170000032 +                        SA7     CALL.1  STORE FOR READ                               BANSOL  132  17
               5170000063 +             SA7     CALL.6  STORE FOR REWIND                             BANSOL  133  18
115 5160000037 +                        SA6     CALL.2  STORE FOR READ                               BANSOL  134  19
               54346                    SA3     A4+B6   X3= ADDR OF LUQ                              BANSOL  135  20
                    10633               BX6     X3                                                   BANSOL  136  21
116 5160000044 +                        SA6     CALL.3  STORE FOR WRITE                              BANSOL  137  22
               5160000051 +             SA6     CALL.4  STORE FOR WRITE                              BANSOL  138  23
117 5160000056 +                        SA6     CALL.5  STORE FOR BACKSPACE                          BANSOL  139  24
               5110000004 +             SA1     NROW2   X1= NROW2                                    BANSOL  140  25
120 5120000003 +                        SA2     NCOLM   X2= NCOLM                                    BANSOL  141  26
               27001                    PX0     B0,X1   PACK NROW2 IN X0                             BANSOL  142  27
                    27502               PX5     B0,X2   PACK NCOLM IN X5                             BANSOL  143  28
121 42405                               DX4     X0*X5   D.P. MULTIPLY                                BANSOL  144  29
          26704                         UX7     B0,X4   UNPACK                                       BANSOL  145  30
               5170000014 +             SA7     LENGTH  STORE LENGTH= NCOLM * NROW2                  BANSOL  146  31
122 5130000005 +                        SA3     NVECT   X3= NVECT                                    BANSOL  147  32
               27603                    PX6     B0,X3   PACK NVECT IN X6                             BANSOL  148  33
                    42506               DX5     X0*X6   D.P. MULTIPLY                                BANSOL  149  34
123 26605                               UX6     B0,X5   UNPACK                                       BANSOL  150  35
          5160000015 +                  SA6     LENGTHB STORE LENGTHB= NVECT * NROW2                  BANSOL  151  36
               63170                    SB1     X7      B1= LENGTH                                   BANSOL  152  37
124 63260                               SB2     X6      B2= LENGTHB                                  BANSOL  153  38
          54100                         SA1     A0      X1= ADDR A(1,1)                              BANSOL  154  39
               10711                    BX7     X1                                                   BANSOL  155  40
                    67504               SB5     -B4     B5= -1                                       BANSOL  156  41
125 5174000063 +                        SA7     CALL.6+B4  STORE FOR REWIND (DUMMY)                  BANSOL  157  42
               54774                    SA7     A7+B4                                                BANSOL  158  43
                    73611               SX6     X1+B1   X6= ADDR A(1,NROW2+1)                        BANSOL  159  44
126 5174000056 +                        SA7     CALL.5+B4  STORE FOR BACKSPACE (DUMMY)               BANSOL  160  45
               54774                    SA7     A7+B4                                                BANSOL  161  46
                    10066               BX0     X6                                                   BANSOL  162  47
127 5174000032 +                        SA7     CALL.1+B4  STORE FOR READ (1ST BLOCK ONLY)           BANSOL  163  48
               5174000051 +             SA7     CALL.4+B4  STORE FOR WRITE                           BANSOL  164  49
130 5170000016 +                        SA7     QA(1.1)                                              BANSOL  165  50
               5160000020 +             SA6     QA(1.P)  STORE A(ISTART)                             BANSOL  166  51
131 5120000003 +                        SA2     NCOLM                                                BANSOL  167  52
               73725                    SX7     X2+B5                                                BANSOL  168  53
                    73461               SX6     X6+B1   X4= ADDR A(1,2*NROW2+1)                      BANSOL  169  54
132 5170000013 +                        SA7     NCOLMM1  STORE (NCOLM-1)                             BANSOL  170  55
               37767                    IX7     X6-X7                                                BANSOL  171  56
                    73645               SX6     X4+B5                                                BANSOL  172  57
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133 5170000010 +                    SA7     QA(2,NN     STORE ADDR A(2,NROW2)                BANSOL  173  1
              5160000022 +          SA6     A(IEND)     STORE                                BANSOL  174  2
134 73705                           SX7     X0+B5       X7= ADDR A(LENGTH)                   BANSOL  175  3
         37662                      IX6     X6-X2                                            BANSOL  176  4
              5170000023 +          SA7     A(LENGT     STORE                                BANSOL  177  5
135 5176000032 +                    SA7     CALL.1+B6   STORE FOR READ (1ST BLOCK)            BANSOL  178  6
              5176000051 +          SA7     CALL.4+B6   STORE FOR WRITE                      BANSOL  179  7
136 5160000012 +                    SA6     QA(1,Z)     STORE ADDR A(1,2*NROW2) -1           BANSOL  180  8
              54104                 SA1     A0+B4       X1= ADDR B(1,1)                      BANSOL  181  9
                   10711            BX7     X1                                               BANSOL  182 10
137 5174000037 +                    SA7     CALL.2+B4   STORE FOR READ (1ST BLOCK ONLY)       BANSOL  183 11
              5174000044 +          SA7     CALL.3+B4   STORE FOR WRITE                      BANSOL  184 12
140 5170000017 +                    SA7     QB(1,1)                                          BANSOL  185 13
              73612                 SX6     X1+B2       X6= ADDR B(1,NROW2+1)                BANSOL  186 14
                   73765            SX7     X6+B5       X7= ADDR B(LENGTHB)                  BANSOL  187 15
141 5160000021 +                    SA6     QB(1,P)     STORE B(ISTARTB)                     BANSOL  188 16
              5170000024 +          SA7     B(LENGT     STORE                                BANSOL  189 17
142 5176000037 +                    SA7     CALL.2+B6   STORE FOR READ (1ST BLOCK ONLY)       BANSOL  190 18
              5176000044 +          SA7     CALL.3+B6   STORE FOR WRITE                      BANSOL  191 19
143 5120000005 +                    SA2     NVECT                                            BANSOL  192 20
              37762                 IX7     X6-X2       X7= ADDR B(1,NROW2)                  BANSOL  193 21
                   73062            SX0     X6+B2       X6= ADDR B(1,2*NROW2+1)              BANSOL  194 22
144 5170000011 +                    SA7     QB(1,NN     STORE                                BANSOL  195 23
              73705                 SX7     X0+B5       X7= ADDR B(IENDB)                    BANSOL  196 24
                   76640            SX6     B4          X6= 1                                BANSOL  197 25
145 5170000025 +                    SA7     B(IENDB     STORE                                BANSOL  198 26
              5160000102 +          SA6     NBB         SET NBB=1                            BANSOL  199 27
                                ** REWIND ALL FILES                                        BANSOL  200 28
146 5110000063 +                    SA1     CALL.6                                           BANSOL  201 29
              0100000000 X          RJ      DISKIO                                           BANSOL  202 30
147 5120000001 +                    SA2     CLTA                                             BANSOL  203 31
              5232000010            SA3     X2+8        X3= ADDR OF LUL                      BANSOL  204 32
150 10633                           BX6     X3                                               BANSOL  205 33
         5160000063 +               SA6     CALL.6                                           BANSOL  206 34
              54160                 SA1     A6                                               BANSOL  207 35
151 0100000000 X                    RJ      DISKIO                                           BANSOL  208 36
152 5120000001 +                    SA2     CLTA                                             BANSOL  209 37
              5232000011            SA3     X2+9        X3= ADDR OF LUU                      BANSOL  210 38
153 10633                           BX6     X3                                               BANSOL  211 39
         5160000063 +               SA6     CALL.6                                           BANSOL  212 40
              54160                 SA1     A6                                               BANSOL  213 41
154 0100000000 X                    RJ      DISKIO                                           BANSOL  214 42
                                ** READ 1ST BLOCK INTO UPPERS                              BANSOL  215 43
155 5110000032 +                    SA1     CALL.1                                           BANSOL  216 44
              0100000000 X          RJ      DISKIO                                           BANSOL  217 45
156 5110000037 +                    SA1     CALL.2                                           BANSOL  218 46
              0100000000 X          RJ      DISKIO                                           BANSOL  219 47
                                ** SET READS FOR LOWER                                     BANSOL  220 48
157 5110000020 +                    SA1     A(ISTAR                                          BANSOL  221 49
              5120000021 +          SA2     B(ISTAR                                          BANSOL  222 50
160 10611                           BX6     X1                                               BANSOL  223 51
         10722                      BX7     X2                                               BANSOL  224 52
              6110000001            SB1     1           B1=1                                 BANSOL  225 53
161 5161000032 +                    SA6     CALL.1+B1                                        BANSOL  226 54
              5171000037 +          SA7     CALL.2+B1                                        BANSOL  227 55
162 5130000022 +                    SA3     A(IEND)                                          BANSOL  228 56
              10633                 BX6     X3                                               BANSOL  229 57
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                    54661          SA6     A6+B1                                                    BANSOL  230  1
163 5140000025 +                   SA4     B(IENDB                                                  BANSOL  231  2
                10744              BX7     X4                                                       BANSOL  232  3
                    54771          SA7     A7+B1                                                    BANSOL  233  4
164 0400000177 +                   EQ      N.7                                                      BANSOL  234  5
                                ** ** ** ** ** ** ** ** * ** ** ** ** ** ** ** ** ** ** ** ** ** BANSOL  235  6
                                ** **  SETTING UP PROCESS COMPLETED ** ** **                        BANSOL  236  7
                                ** ** ** ** ** ** ** ** * ** ** ** ** ** ** ** ** ** ** ** ** ** BANSOL  237  8
                                ** INCREASE NBB BY 1                                               BANSOL  238  9
165 6140000001                  F.10    SB4     1                                                  BANSOL  239 10
                5150000102 +            SA5     NBB                                                BANSOL  240 11
166 46000                               NO                                                         BANSOL  241 12
                73654                   SX6     X5+B4                                              BANSOL  242 13
                5160000102 +            SA6     NBB             NBB= NBB+1                         BANSOL  243 14
                                ** SETUP TO DO WORK OF FORTRAN LOOPS 20 AND 30                     BANSOL  244 15
167 5150000016 +                        SA5     QA(1,1)                                            BANSOL  245 16
                5120000020 +            SA2     QA(1,P)         X2= ADDR A(1,NROW2+1)              BANSOL  246 17
170 63150                               SB1     X5                                                 BANSOL  247 18
                63220                   SB2     X2                                                 BANSOL  248 19
                5130000017 +            SA3     QB(1,1)                                            BANSOL  249 20
171 66720                               SB7     B2              EXIT ADDR FOR LOOP 35              BANSOL  250 21
                63330                   SB3     X3              B3=                                BANSOL  251 22
                5140000021 +            SA4     QB(1,P)         X4= ADDR B(1,NROW2+1)              BANSOL  252 23
172 63540                               SB5     X4              B5=                                BANSOL  253 24
                66650                   SB6     B5              EXIT ADDR FOR LOOP 25              BANSOL  254 25
                46000                   NO                                                         BANSOL  255 26
                    46000               NO                                                         BANSOL  256 27
                                ** LOOP 35 SHIFTS LOWER A BLOCK TO UPPER                           BANSOL  257 28
173 56220                       F.35    SA2     B2                                                 BANSOL  258 29
                10622                   BX6     X2                                                 BANSOL  259 30
                    56610               SA6     B1                                                 BANSOL  260 31
                        66114           SB1     B1+B4                                              BANSOL  261 32
174 66224                               SB2     B2+B4                                              BANSOL  262 33
                0717000173 +            GT      B7,B1,F.35                                         BANSOL  263 34
                    46000               NO                                                         BANSOL  264 35
                                ** LOOP 25 SHIFTS LOWER B BLOCK TO UPPER                           BANSOL  265 36
175 56450                       F.25    SA4     B5                                                 BANSOL  266 37
                10744                   BX7     X4                                                 BANSOL  267 38
                    56730               SA7     B3                                                 BANSOL  268 39
                        66554           SB5     B5+B4                                              BANSOL  269 40
176 66334                               SB3     B3+B4                                              BANSOL  270 41
                0736000175 +            GT      B6,B3,F.25                                         BANSOL  271 42
                    46000               NO                                                         BANSOL  272 43
                                ** CHECK FOR LAST BLOCK                                            BANSOL  273 44
177 5110000007 +                N.7     SA1     NUMBLK                                             BANSOL  274 45
                5120000102 +            SA2     NBB                                                BANSOL  275 46
200 37012                               IX0     X1-X2                                              BANSOL  276 47
                0310000210 +            NZ      X0,F.40                                            BANSOL  277 48
                    46000               NO                                                         BANSOL  278 49
                                ** LAST BLOCK.  SET A LOWER AND B LOWER TO 0.                       BANSOL  279 50
201 6140000001                          SB4     1                                                  BANSOL  280 51
                5120000020 +            SA2     QA(1,P)         X2= ADDR A(1,NROW2+1)              BANSOL  281 52
202 63220                               SB2     X2                                                 BANSOL  282 53
                5110000022 +            SA1     A(IEND)                                            BANSOL  283 54
                    63710               SB7     X1              EXIT ADDR FOR LOOP 36              BANSOL  284 55
203 5140000021 +                        SA4     QB(1,P)         X4= ADDR B(1,NROW2+1)              BANSOL  285 56
                5150000025 +            SA5     B(IENDB                                            BANSOL  286 57
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                         SB5     X4                                                BANSOL  287   1
                         SB6     X5          EXIT ADDR FOR LOOP 26                 BANSOL  288   2
                         MX6     0                                                 BANSOL  289   3
                         NO                                                        BANSOL  290   4
                   ** LOOP 36 SETS LOWER A BLOCK TO 0.                             BANSOL  291   5
204 63540        F.36    SA6     B2                                                BANSOL  292   6
        63650            SB2     B2+B4                                             BANSOL  293   7
            43600        GE      B7,B2,F.36                                        BANSOL  294   8
                46000    ** LOOP 26 SETS LOWER B BLOCK TO 0.                       BANSOL  295   9
206 56650        F.26    SA6     B5                                                BANSOL  296  10
        66554            SB5     B5+B4                                             BANSOL  297  11
            0665000206 + GE      B6,B5,F.26                                        BANSOL  298  12
207 0400000212 +         EQ      F.90                                              BANSOL  299  13
                   ** READ  BLOCK FROM DISK                                        BANSOL  300  14
210 5110000032 +  F.40   SA1     CALL.1                                            BANSOL  301  15
            0100000000 X RJ      DISKIO                                            BANSOL  302  16
211 5110000037 +         SA1     CALL.2                                            BANSOL  303  17
            0100000000 X RJ      DISKIO                                            BANSOL  304  18
                   **                                                              BANSOL  305  19
                   ** REDUCE BLOCK ** ** ** ** ** ** ** ** ** ** ** ** **         BANSOL  306  20
                   **                                                              BANSOL  307  21
                   ** SET UP FOR LOOP 140                                          BANSOL  308  22
212 6140000001   F.90    SB4     1           B4= 1                    * * * * *    BANSOL  309  23
            5110000016 + SA1     QA(1,1)     X1= ADDR A(1,1)                       BANSOL  310  24
213 5120000017 +         SA2     QB(1,1)     X2= ADDR B(1,1), FOR LOOP 100         BANSOL  311  25
        10411            BX6     X1                                                BANSOL  312  26
            10722        BX7     X2                                                BANSOL  313  27
214 5160000070 +         SA6     QA(1,N)     STORE                                 BANSOL  314  28
            5170000071 + SA7     QB(1,N)     STORE                                 BANSOL  315  29
215 5110000003 +         SA1     NCOLM                                             BANSOL  316  30
            5120000005 + SA2     NVECT                                             BANSOL  317  31
216 63310        F.140   SB3     X1                       * * * * *    BANSOL  318  32
        63620            SB6     X2                       * * * * *    BANSOL  319  33
                   ** BEGIN LOOP 140                                               BANSOL  320  34
217 5140000070 +         SA4     QA(1,N)     X4= ADDR A(1,N)          * * * * *    BANSOL  321  35
            53140        SA1     X4          X1= A(1,N)                            BANSOL  322  36
220 0301000261 +         ZR      X1,N.3      JUMP TO END OF LOOP 140 IF A(1,N)=0.  BANSOL  323  37
            5120000002 + SA2     FONE        X2= 1.0                               BANSOL  324  38
221 44621                FX6     X2/X1       X6= 1./A(1,N)                         BANSOL  325  39
        10166            BX1     X6          X1=                      * * * * *    BANSOL  326  40
            5160000073 + SA6     PIVOT       STORE                                 BANSOL  327  41
                   ** SET UP FOR LOOP 100                                          BANSOL  328  42
222 5120000071 +         SA2     QB(1,N)     X2= ADDR B(1,N)                       BANSOL  329  43
        63520            SB5     X2          B5=                                   BANSOL  330  44
            76756        SX7     B5+B6       ADD NVECT                             BANSOL  331  45
223 63770                SB7     X7          B7= EXIT ADDR FOR LOOP 100            BANSOL  332  46
        46000            NO                                                        BANSOL  333  47
            5170000076 + SA7     QB(1,I)     ADDR B(1,N+1), FOR LOOP 120           BANSOL  334  48
                   ** BEGIN LOOP 100                                               BANSOL  335  49
224 56250        F.100   SA2     B5          X2= (B(L,N)                           BANSOL  336  50
        40712            FX7     X1*X2       X7= B(L,N) / A(1,N)                   BANSOL  337  51
            56750        SA7     B5          STORE IN B(L,N)                       BANSOL  338  52
                66554    SB5     B5+B4       ADD 1 TO ADDRESS                      BANSOL  339  53
225 0757000224 +         GT      B7,B5,F.100                                       BANSOL  340  54
                   ** END OF LOOP 100                                              BANSOL  341  55
                   ** SET UP FOR LOOP 105                                          BANSOL  342  56
        73743            SX7     X4+B3       ADD NCOLM TO ADDR                     BANSOL  343  57
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                    73644                SX6     X4+B4       X6= ADDR A(2,N)                                  BANSOL   344   1
225 67534                                SB5     B3-B4       INCREMENT FOR EXIT ADDR FROM LOOP 11             BANSOL   345   2
          63170                          SB1     X7                                                           BANSOL   346   3
               5160000072 +              SA6     QA(L,N)     STORE                                            BANSOL   347   4
                                  ** BEGIN LOOP 105                                                          BANSOL   348   5
227 57314                        F.105     SA3     B1-B4       X3= A(MMM,N)                                    BANSOL   349   6
          0313000232 +                     NZ      X3,F.106    JUMP OUT IF NON-ZERO                             BANSOL   350   7
                    67114                  SB1     B1-B4                                                        BANSOL   351   8
230 67554                                SB5     B5-B4                                                        BANSOL   352   9
          0450000261 +                     ZR      B5,N,3                                                       BANSOL   353  10
231 0400000227 +                           EQ      F.105                                                        BANSOL   354  11
                                  ** END OF LOOP 105                                                         BANSOL   355  12
                                  ** SET UP FOR LOOP 130                                                     BANSOL   356  13
232 5170000075 +                 F.106     SA7     QA(1,I)     ADDR OF A(1,I) FOR LOOP 110                  BANSOL   357  14
                    76710                  SX7     B1                                                           BANSOL   358  15
                         76650             SX6     B5                                                           BANSOL   359  16
233 5170000074 +                           SA7     XF.130      EXIT ADDR FOR LOOP 130                           BANSOL   360  17
               5160000103 +                SA6     XIF.110     STORE                                            BANSOL   361  18
                                  ** BEGIN LOOP 130                                                          BANSOL   362  19
234 5110000072 +                 F.130     SA1     QA(L,N)     X1= ADDR A(L,N)          * * * * *           BANSOL   363  20
                    53210                  SA2     X1          X2= A(L,N)               * * * * *           BANSOL   364  21
235 0302000251 +                           ZR      X2,N.4      JUMP IF A(L,N)=0.0                               BANSOL   365  22
               5130000073 +                SA3     PIVOT                                                        BANSOL   366  23
                                  ** SET UP FOR LOOP 110                                                     BANSOL   367  24
236 5140000075 +                           SA4     QA(1,I)     X4= ADDR A(1,I)                                  BANSOL   368  25
                    40323                  FX3     X2*X3       X3= A(L,N) / A(1,N)      * * * * *           BANSOL   369  26
                         63240             SB2     X4          B2=                                              BANSOL   370  27
237 5150000103 +                           SA5     XIF.110     X5= INCREMENT FOR EXIT ADDR LOOP 110             BANSOL   371  28
                    63110                  SB1     X1          B1= ADDR A(L,N)                                  BANSOL   372  29
                         36551             IX5     X5+X1                                                        BANSOL   373  30
240 63750                                  SB7     X5          SET EXIT ADDR FOR LOOP 110                       BANSOL   374  31
                                  ** BEGIN LOOP 110 **                                                       BANSOL   375  32
241 56520                        F.110     SA5     B2          SET X5= A(J,I)                                   BANSOL   376  33
          56410                            SA4     B1          SET X4= A(K,N)                                   BANSOL   377  34
                    40034                  FX0     X3*X4       SET X0= TEMP * A(K,N)                            BANSOL   378  35
                         31750             FX7     X5-X0       SET X7= A(J,I) - TEMP * A(K,N)                   BANSOL   379  36
242 24607                                  NX6     X7          NORMALIZE RESULT                                 BANSOL   380  37
          56620                            SA6     B2          STORE RESULT IN A(J,I)                           BANSOL   381  38
                    66242                  SB2     B4+B2       INCREMENT FOR NEXT A(J,I)                        BANSOL   382  39
                         66141             SB1     B4+B1       INCREMENT FOR NEXT A(K,N)                        BANSOL   383  40
243 0717000241 +                           GT      B7,B1,F.110 CHECK FOR END OF LOOP 110                        BANSOL   384  41
                                  ** END OF LOOP 110 **                                                      BANSOL   385  42
                                  ** SET UP FOR LOOP 120                                                     BANSOL   386  43
               5140000076 +                SA4     QB(1,I)     X4= ADDR B(1,I)                                  BANSOL   387  44
244 63240                                  SB2     X4          B2=                                              BANSOL   388  45
          46000                            NO                                                                   BANSOL   389  46
               5150000071 +                SA5     QB(1,N)     X5= ADDR B(1,N)                                  BANSOL   390  47
245 63150                                  SB1     X5          B1=                                              BANSOL   391  48
          44000                            NO                                                                   BANSOL   392  49
               66716                       SB7     B1+B6       SET EXIT ADDR FOR LOOP 120                       BANSOL   393  50
                                  ** BEGIN LOOP 120 **                                                       BANSOL   394  51
246 56520                        F.120     SA5     B2          X5= B(K,I)                                       BANSOL   395  52
          56410                            SA4     B1          X4= B(K,N)                                       BANSOL   396  53
                    40024                  FX0     X2*X4       X0= TEMPA * B(K,N)                               BANSOL   397  54
                         31750             FX7     X5-X0       X7= B(K,I) - TEMPA * B(K,N)                      BANSOL   398  55
247 24607                                  NX6     X7          NORM.                                            BANSOL   399  56
          56620                            SA6     B2          STORE RESULT IN B(K,I)                           BANSOL   400  57
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```
                66242
                     66141
250  0717000246 +
                10633
                     53610
251  63210
          66224
               5120000074 +
252  63120
          0621000261 +
                     76620
253  5110000075 +
                73713
254  5160000072 +
               5170000075 +
255  5130000103 +
                7263777776
256  5160000103 +
               5150000076 +
257  73756
          5170000076 +
260  0400000234 +

261  5110000070 +
               5130000020 +
262  63113
          63730
               0617000266 +
263  5130000071 +
                73736
                     76610
264  5170000071 +
               5160000070 +
265  0400000217 +




266  5110000007 +
               5120000102 +
267  37012
          0300000273 +
                     46000
270  5110000044 +
               0100000000 X
271  5110000051 +
               0100000000 X
272  0400000165 +
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                SB2     B4+B2                                          BANSOL  401  1
                SB1     B4+B1                                          BANSOL  402  2
                GT      B7,B1,F.120                                    BANSOL  403  3
                                                                       BANSOL  404  4
** END OF LOOP 120 **                                                  BANSOL  405  5
                BX6     X3              X6= A(L,N) / A(1,N)            BANSOL  406  6
                SA6     X1              STORE AT A(L,N)                BANSOL  407  7
** CHECK FOR END OF LOOP 130                                           BANSOL  408  8
N.4             SB2     X1              B2=                            BANSOL  409  9
                SB2     B2+B4           ADD 1                          BANSOL  410  10
                SA2     XF.130          X2= EXIT ADDRESS FOR LOOP 130  BANSOL  411  11
                SB1     X2              B1=                            BANSOL  412  12
                LE      B1,B2,N.3                                      BANSOL  413  13
                SX6     B2                                             BANSOL  414  14
** PREPARE FOR NEXT PASS THROUGH LOOP 110                              BANSOL  415  15
                SA1     QA(1,I)         X1= ADDR A(1,I)                BANSOL  416  16
                SX7     X1+B3           ADD                            BANSOL  417  17
                SA6     QA(L,N)         STORE FOR NEXT PASS THROUGH LOOP 130 BANSOL  418  18
                SA7     QA(1,I)         STORE NEXT ADDR A(1,I)         BANSOL  419  19
                SA3     XIF.110         X3= INCREMENT FOR EXIT FROM 110 BANSOL  420  20
                SX6     X3-1            SUBTRACT 1                     BANSOL  421  21
                SA6     XIF.110         STORE NEW INCREMENT            BANSOL  422  22
** PREPARE FOR NEXT PASS THROUGH LOOP 120                              BANSOL  423  23
                SA5     QB(1,I)         X5= ADDR B(1,I)                BANSOL  424  24
                SX7     X5+B6           ADD NVECT                      BANSOL  425  25
                SA7     QB(1,I)         STORE NEXT ADDR B(1,I)         BANSOL  426  26
                ZR      F.130                                          BANSOL  427  27
** END OF LOOP 130                                                     BANSOL  428  28
** CHECK FOR END OF LOOP 140                                          BANSOL  429  29
N.3             SA1     QA(1,N)         X1= ADDR A(1,N)                BANSOL  430  30
                SA3     A(ISTAR         X3= EXIT ADDR FOR LOOP 140     BANSOL  431  31
                SB1     X1+B3           NEXT ADDR A(1,N)               BANSOL  432  32
                SB7     X3                                             BANSOL  433  33
                LE      B7,B1,N.5                                      BANSOL  434  34
** PREPARE FOR NEXT PASS THROUGH LOOP 140                              BANSOL  435  35
                SA3     QB(1,N)         X3= ADDR B(1,N)                BANSOL  436  36
                SX7     X3+B6           ADD NVECT                      BANSOL  437  37
                SX6     B1                                             BANSOL  438  38
                SA7     QB(1,N)         STORE NEXT ADDR B(1,N)         BANSOL  439  39
                SA6     QA(1,N)         STORE NEXT ADDR A(1,N)         BANSOL  440  40
                ZR      F.140                                          BANSOL  441  41
** LOOP 140 FINISHED                                                   BANSOL  442  42
**                                                                     BANSOL  443  43
** END OF REDUCTION **  **  **  **  **  **  **  **  **  **  **        BANSOL  444  44
**                                                                     BANSOL  445  45
** CHECK FOR LAST BLOCK                                               BANSOL  446  46
N.5             SA1     NUMBLK                                         BANSOL  447  47
                SA2     NBB                                            BANSOL  448  48
                IX0     X1-X2                                          BANSOL  449  49
                ZR      X0,N.8                                         BANSOL  450  50
                NO                                                     BANSOL  451  51
** WRITE REDUCED BLOCK                                                BANSOL  452  52
                SA1     CALL.3                                         BANSOL  453  53
                RJ      DISKIO                                         BANSOL  454  54
                SA1     CALL.4                                         BANSOL  455  55
                RJ      DISKIO                                         BANSOL  456  56
                ZR      F.10                                           BANSOL  457  57
**  REDUCTION FINISHED, RESET DISKIO READS
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273  5110000001 +                N.8       SA1           CLTA                                          BANSOL   458   1
                 5120000016 +               SA2           QA(1,1)      X2= ADDR A(1,1)                  BANSOL   459   2
274  5130000023 +                           SA3           A(LENGT      X3= ADDR A(NCOLM,2*NROW2)        BANSOL   460   3
                   10622                    BX6           X2                                            BANSOL   461   4
275  5164000032 +                           SA6           CALL.1+B4                                     BANSOL   462   5
                   10733                    BX7           X3                                            BANSOL   463   6
                        54764               SA7           A6+B4                                         BANSOL   464   7
276  5241000011                             SA4           X1+9         X4= ADDR OF LUQ                  BANSOL   465   8
                 5150000017 +               SA5           QB(1,1)      X5= ADDR OF B(1,1)               BANSOL   466   9
277  10644                                  BX6           X4                                            BANSOL   467  10
       10755                                BX7           X5                                            BANSOL   468  11
                 5160000032 +               SA6           CALL.1                                        BANSOL   469  12
300  5160000037 +                           SA6           CALL.2                                        BANSOL   470  13
                 5110000024 +               SA1           B(LENGT                                       BANSOL   471  14
301  54764                                  SA7           A6+B4                                         BANSOL   472  15
       10611                                BX6           X1                                            BANSOL   473  16
            54674                           SA6           A7+B4                                         BANSOL   474  17
                                    **                                                                  BANSOL   475  18
                                    ** BACK INSTITUTION **  **  **  **  **  **  **  **  **  **          BANSOL   476  19
                                    **                                                                  BANSOL   477  20
                                    ** SET UP FOR LOOP 190 OUTER                                       BANSOL   478  21
302  6140000001                     F.170     SB4           1            B4= 1                            BANSOL   479  22
                 5110000010 +               SA1           QA(2,NN      X1= ADDR A(2,NROW2)              BANSOL   480  23
303  10611                                  BX6           X1           X6=                              BANSOL   481  24
       5120000011 +                         SA2           QB(1,NN      X2= ADDR B(1,NR                  BANSOL   482  25
            63320                           SB3           X2           B3=                              BANSOL   483  26
304  5160000077 +                           SA6           QA(2,N)      STORE FOR LOOP 1800              BANSOL   484  27
                 5130000005 +               SA3           NVECT                                         BANSOL   485  28
305  73633                                  SX6           X3+B3        X6= ADDR B(1,NROW2+1)            BANSOL   486  29
       46000                                NO                                                          BANSOL   487  30
                 5160000100 +               SA6           QB(1,L)      STORE FOR LOOP 1801              BANSOL   488  31
306  5140000012 +                           SA4           QA(1,Z)      X4= ADDR A(1,2*MROW2) -1         BANSOL   489  32
                 5150000102 +               SA5           NBB                                           BANSOL   490  33
307  36645                                  IX6           X4+X5        X6= ADDR A(NBB,2*NROW2)          BANSOL   491  34
       46000                                NO                                                          BANSOL   492  35
                 5160000101 +               SA6           QA(NBB.      STORE FOR LOOP 1901              BANSOL   493  36
                                    ** BEGIN LOOP 190 OUTER                                            BANSOL   494  37
                                    ** SET UP FOR LOOPS 180                                            BANSOL   495  38
310  5110000077 +                   F.1900    SA1           QA(2,N)      X1= ADDR A(2,N)                  BANSOL   496  39
                 5120000013 +               SA2           NCOLMM1                                       BANSOL   497  40
311  63510                                  SB5           X1           B5=                              BANSOL   498  41
       36012                                IX0           X1+X2        X0= EXIT ADDR FOR LOOP 1800      BANSOL   499  42
                 5130000100 +               SA3           QB(1,L)      X3= ADDR OF B(1,N+1)             BANSOL   500  43
312  63600                                  SB6           X0                                            BANSOL   501  44
       63230                                SB2           X3                                            BANSOL   502  45
            66720                           SB7           B2           EXIT ADDR FOR LOOP 1801          BANSOL   503  46
                                    ** BEGIN LOOP 180 OUTER                                            BANSOL   504  47
313  46000                          F.1800    NO                                                          BANSOL   505  48
       46000                                NO                                                          BANSOL   506  49
            56350                           SA3           B5           X3= A(K,N)= TEMPA                BANSOL   507  50
                                    ** SET UP FOR LOOP 180 INNER                                       BANSOL   508  51
                 66130                      SB1           B3                                            BANSOL   509  52
                                    ** BEGIN LOOP 180 INNER                                            BANSOL   510  53
314  56110                          F.1801    SA1           B1           X1= B(J,N)                       BANSOL   511  54
       56220                                SA2           B2           X1= B(J,L)                       BANSOL   512  55
            40032                           FX0           X3*X2        X0= TEMPA * B(J,L)               BANSOL   513  56
                 31610                      FX6           X1-X0        X6= B(J,N) - X0                  BANSOL   514  57
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315 24706                       NX7     X6          NORMALIZE                                   BANSOL  515  1
        56710                   SA7     B1          STORE IN B(J,N)                             BANSOL  516  2
              66114             SB1     B1+B4       ADD 1                                       BANSOL  517  3
                    66224       SB2     B2+B4       ADD 1                                       BANSOL  518  4
316 0717000314 +                GT      B7,B1,F.180I                                            BANSOL  519  5
                                ** END OF LOOP 180 INNER                                        BANSOL  520  6
                                ** NOTE-- ADDR IN B2 IS CORRECT FOR NEXT PASS IN 180I           BANSOL  521  7
              66554             SB5     B5+B4       SET FOR NEXT A(K,N)                         BANSOL  522  8
317 0756000313 +                GT      B6,B5,F.1800                                            BANSOL  523  9
                                ** END OF LOOP 180 OUTER                                        BANSOL  524  10
                                ** SET UP FOR LOOP 190 INNER                                    BANSOL  525  11
              5110000015 +      SA1     LENGTHB                                                 BANSOL  526  12
320 66130                       SB1     B3          B1= ADDR B(1,N)                             BANSOL  527  13
        63213                   SB2     X1+B3       B2= ADDR B(1,NM)                            BANSOL  528  14
              5130000005 +      SA3     NVECT                                                   BANSOL  529  15
                                ** ADDR IN B7 IS CORRECT FOR EXIT ADDR FOR LOOP 190I            BANSOL  530  16
321 46000                       NO                                                              BANSOL  531  17
        46000                   NO                                                              BANSOL  532  18
              5120000101 +      SA2     QA(NBB.     X2= ADDR A(NBB,NM)                          BANSOL  533  19
322 63520                       SB5     X2          B5=                                         BANSOL  534  20
        5140000007 +            SA4     NUMBLK                                                  BANSOL  535  21
                    63640       SB6     X4          B6= INCREMENT FOR LOOP 190I                 BANSOL  536  22
                                ** BEGIN LOOP 190 INNER                                         BANSOL  537  23
323 56110               F.190I  SA1     B1          X1= B(K,N)                                  BANSOL  538  24
        10611                   BX6     X1                                                      BANSOL  539  25
              56620             SA6     B2          STORE IN B(K,NM)                            BANSOL  540  26
                    56650       SA6     B5          STORE IN A(NBB+J,NM)                        BANSOL  541  27
324 66114                       SB1     B1+B4                                                   BANSOL  542  28
        66224                   SB2     B2+B4                                                   BANSOL  543  29
              66556             SB5     B5+B6                                                   BANSOL  544  30
325 0717000323 +                GT      B7,B1,F.190I                                            BANSOL  545  31
                                ** END OF LOOP 190 INNER                                        BANSOL  546  32
                                ** CHECK FOR END OF LOOP 190 OUTER                              BANSOL  547  33
              5110000017 +      SA1     QB(1,1)     X1= ADDR B(1,1)                             BANSOL  548  34
326 63610                       SB6     X1                                                      BANSOL  549  35
        0663000335 +            LE      B3,B6,N.6   LOOP 1900 FINISHED                          BANSOL  550  36
                                ** PREPARE FOR NEXT PASS THROUGH 1900                           BANSOL  551  37
                    76730       SX7     B3                                                      BANSOL  552  38
327 5170000100 +                SA7     QB(1,L)     SET NEXT ADDR B(1,L)= B(1,N+1)              BANSOL  553  39
              5120000005 +      SA2     NVECT                                                   BANSOL  554  40
330 63520                       SB5     X2                                                      BANSOL  555  41
        46000                   NO                                                              BANSOL  556  42
              5130000077 +      SA3     QA(2,N)     X= ADDR A(2,N)                              BANSOL  557  43
331 5140000003 +                SA4     NCOLM                                                   BANSOL  558  44
              67335             SB3     B3-B5       SET NEXT ADDR B(1,N)                        BANSOL  559  45
                    37634       IX6     X3-X4                                                   BANSOL  560  46
332 5160000077 +                SA6     QA(2,N)     STORE NEXT ADDR A(2,N)                      BANSOL  561  47
              5150000101 +      SA5     QA(NBB.                                                 BANSOL  562  48
333 37754                       IX7     X5-X4                                                   BANSOL  563  49
        46000                   NO                                                              BANSOL  564  50
              5170000101 +      SA7     QA(NBB.     STORE NEXT ADDR A(NBB,NM)                   BANSOL  565  51
334 0400000310 +                ZR      F.1900                                                  BANSOL  566  52
                                ** END OF LOOP 190 OUTER                                        BANSOL  567  53
                                **                                                              BANSOL  568  54
335 5110000102 +        N.6     SA1     NBB         DECREASE NBB BY 1                           BANSOL  569  55
              7251777776        SX6     X1-1                                                    BANSOL  570  56
336 0306000346 +                ZR      X6,F.230    CHECK IF 0                                  BANSOL  571  57
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60250600

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                5160000102 +          SA6       NBB                                                    BANSOL   572   1
                                      ** READ PRECEEDING REDUCED BLOCK                                 BANSOL   573   2
337  5110000056 +                     SA1       CALL.5                                                 BANSOL   574   3
                0100000000 x          RJ        DISKIO                                                 BANSOL   575   4
340  5110000032 +                     SA1       CALL.1                                                 BANSOL   576   5
                0100000000 x          RJ        DISKIO                                                 BANSOL   577   6
341  5110000056 +                     SA1       CALL.5                                                 BANSOL   578   7
                0100000000 x          RJ        DISKIO                                                 BANSOL   579   8
342  5110000056 +                     SA1       CALL.5                                                 BANSOL   580   9
                0100000000 x          RJ        DISKIO                                                 BANSOL   581  10
343  5110000037 +                     SA1       CALL.2                                                 BANSOL   582  11
                0100000000 x          RJ        DISKIO                                                 BANSOL   583  12
344  5110000056 +                     SA1       CALL.5                                                 BANSOL   584  13
                0100000000 x          RJ        DISKIO                                                 BANSOL   585  14
345  0400000302 +                     ZR        F.170                                                  BANSOL   586  15
                                      **                                                               BANSOL   587  16
                                      ** SOLUTION COMPLETE. TRANSFER SOLUTION TO B (COVERING A)        BANSOL   588  17
                                      **                                                               BANSOL   589  18
                                      ** SET UP FOR LOOPS 240                                          BANSOL   590  19
346  5110000004 +                     F.230     SA1       NROW2                                        BANSOL   591  20
                5120000007 +                   SA2       NUMBLK                                       BANSOL   592  21
347  27001                            PX0       B0,X1                                                  BANSOL   593  22
          27502                      PX5       B0,X2                                                  BANSOL   594  23
               42405                 UX4       X0*X5                                                  BANSOL   595  24
                    26004            UX0       B0,X4     X0= NROW2 * NUMBLK      * * * *              BANSOL   596  25
350  6140000001                       SB4       1                                                      BANSOL   597  26
                5110000003 +          SA1       NCOLM                                                  BANSOL   598  27
351  5120000020 +                     SA2       A(ISTAR   X2= ADDR A(1,NROW2+1    * * * *              BANSOL   599  28
                5140000017 +          SA4       QB(1,1)   X4= ADDR B(1,1)      * * * *                BANSOL   600  29
352  63510                            SB5       X1        BK= NCOLM                                    BANSOL   601  30
          76740                      SX7       B4        X7= J = 1               * * * *              BANSOL   602  31
               5150000022 +          SA5       A(IEND)   X5= ADDR A(IEND)       * * * *              BANSOL   603  32
353  63120                            F.2400    SB1       X2                                           BANSOL   604  33
                                      ** BEGIN LOOP 240 OUTER                                          BANSOL   605  34
          66210                      SB2       B1                                                     BANSOL   606  35
               63340                 SB3       X4                                                     BANSOL   607  36
                    63654            SB6       X5+B4     EXIT ADDR FOR 240I                           BANSOL   608  37
354  63703                            SB7       X0+B3     EXIT ADDR FOR 240I                           BANSOL   609  38
                                      ** BEGIN LOOP 240 INNER                                          BANSOL   610  39
355  56110                            F.240I    SA1       B1        X1=A(M+L,NM)                       BANSOL   611  40
          10611                      BX6       X1                                                     BANSOL   612  41
               56630                 SA6       B3        STORE AT B(K)                                BANSOL   613  42
                    66115            SB1       B1+B5                                                  BANSOL   614  43
356  66334                            SB3       B3+B4                                                  BANSOL   615  44
          0716000355 +                GT        B6+B1,F.240I    CHECK FOR THE END OF A ROW             BANSOL   616  45
                    66664            SB6       B6+B4                                                  BANSOL   617  46
357  66224                            SB2       B2+B4                                                  BANSOL   618  47
          66120                      SB1       B2                                                     BANSOL   619  48
               0737000355 +          GT        B7,B3,F.240I    CHECK FOR THE LAST ROW                 BANSOL   620  49
                                      ** END OF LOOP 240 INNER                                         BANSOL   621  50
                                      ** CHECK FOR END OF LOOP 240 OUTER                               BANSOL   622  51
360  5110000005 +                     SA1       NVECT                                                  BANSOL   623  52
               37317                  IX3       X1-X7                                                  BANSOL   624  53
361  0303000364 +                     ZR        X3,N.10   JUMP OUT IF J=NVECT                          BANSOL   625  54
                5110000007 +          SA1       NUMBLK                                                 BANSOL   626  55
362  73774                            SX7       X7+B4     J=J+1                                        BANSOL   627  56
          36221                      IX2       X2+X1     SET ADDR FOR NEXT PASS                       BANSOL   628  57
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82 60 00

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                    5130000006 +            SA3     NSOLBLK                                         BANSOL  629  1
363  36551                                  IX5     X5+X1       SET ADDR FOR NEXT PASS              BANSOL  630  2
          36443                            IX4     X4+X3       SET ADDR FOR NEXT PASS              BANSOL  631  3
                    0400000353 +            ZR      F.2400                                          BANSOL  632  4
                                    ** END OF LOOP 2400                                             BANSOL  633  5
                                    ** END OF ROUTINE                                               BANSOL  634  6
364  5140000000 +                  N.10      SA4     SAVEA0      PICK UP ORIGINAL A0                 BANSOL  635  7
                    53040                   SA0     X4          RESTORE A0                          BANSOL  636  8
365  0400000104 +                           ZR      BANSOL                                          BANSOL  637  9
366                                         END                                                     BANSOL  638 10

                  453008 CM  STORAGE USED          637 STATEMENTS      78 SYMBOLS                          12
                             MODEL 73 ASSEMBLY     3.548 SECONDS       287 REFERENCES                      13
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SYMBOLIC REFERENCE TABLE.

| | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| A(IEND) | 22 | PROGRAM* | 3/05 L | 5/02 S | 5/56 | 6/54 | 12/32 | | | | | | | 1 |
| A(ISTAR | 20 | PROGRAM* | 3/01 L | 5/49 | 9/30 | 12/28 | | | | | | | | 2 |
| A(LENGT | 23 | PROGRAM* | 3/06 L | 5/05 S | 10/03 | | | | | | | | | 3 |
| BANSOL | 104 | PROGRAM* | 3/45 E | 3/46 L | 13/09 | | | | | | | | | 4 |
| B(IENDB | 25 | PROGRAM* | 3/08 L | 5/26 S | 6/02 | 6/57 | | | | | | | | 5 |
| B(ISTAR | 21 | PROGRAM* | 3/03 L | 5/50 | | | | | | | | | | 6 |
| B(LENGT | 24 | PROGRAM* | 3/07 L | 5/17 S | 10/14 | | | | | | | | | 7 |
| CALL.1 | 32 | PROGRAM* | 3/13 L | 4/48 S | 5/44 | 7/15 | 10/12 S | | | | | | | 8 |
| | | | 4/17 S | 5/06 S | 5/54 S | 10/05 S | 12/05 | | | | | | | 9 |
| CALL.2 | 37 | PROGRAM* | 3/16 L | 5/11 S | 5/46 | 7/17 | 12/11 | | | | | | | 10 |
| | | | 4/19 S | 5/18 S | 5/55 S | 10/13 S | | | | | | | | 11 |
| CALL.3 | 44 | PROGRAM* | 3/19 L | 4/22 S | 5/12 S | 5/19 S | 9/52 | | | | | | | 12 |
| CALL.4 | 51 | PROGRAM* | 3/22 L | 4/23 S | 4/49 S | 5/07 S | 9/54 | | | | | | | 13 |
| CALL.5 | 56 | PROGRAM* | 3/25 L | 4/24 S | 4/45 S | 12/03 | 12/07 | 12/09 | 12/13 | | | | | 14 |
| CALL.6 | 63 | PROGRAM* | 3/28 L | 4/18 S | 4/42 S | 5/29 | 5/34 S | 5/40 S | | | | | | 15 |
| CLTA | 1 | PROGRAM* | 2/43 L | 3/51 S | 5/31 | 5/37 | 10/01 | | | | | | | 16 |
| DISKIO | 0 | EXTERNAL* | 3/43 X | 5/36 | 5/45 | 7/16 | 9/53 | 12/04 | 12/08 | 12/12 | | | | 17 |
| | | | 5/30 | 5/42 | 5/47 | 7/18 | 9/55 | 12/06 | 12/10 | 12/14 | | | | 18 |
| FONE | 2 | PROGRAM* | 2/44 L | 7/38 | | | | | | | | | | 19 |
| F.10 | 165 | PROGRAM* | 6/10 L | 9/56 | | | | | | | | | | 20 |
| F.100 | 224 | PROGRAM* | 7/50 L | 7/54 | | | | | | | | | | 21 |
| F.105 | 227 | PROGRAM* | 8/06 L | 8/11 | | | | | | | | | | 22 |
| F.106 | 232 | PROGRAM* | 8/07 | 8/14 L | | | | | | | | | | 23 |
| F.110 | 241 | PROGRAM* | 8/33 L | 8/41 | | | | | | | | | | 24 |
| F.120 | 246 | PROGRAM* | 8/52 L | 9/03 | | | | | | | | | | 25 |
| F.130 | 234 | PROGRAM* | 8/20 L | 9/26 | | | | | | | | | | 26 |
| F.140 | 217 | PROGRAM* | 7/35 L | 9/40 | | | | | | | | | | 27 |
| F.170 | 302 | PROGRAM* | 10/22 L | 12/15 | | | | | | | | | | 28 |
| F.180I | 314 | PROGRAM* | 10/54 L | 11/05 | | | | | | | | | | 29 |
| F.180O | 313 | PROGRAM* | 10/48 L | 11/09 | | | | | | | | | | 30 |
| F.190I | 323 | PROGRAM* | 11/24 L | 11/31 | | | | | | | | | | 31 |
| F.190O | 310 | PROGRAM* | 10/39 L | 11/52 | | | | | | | | | | 32 |
| F.230 | 346 | PROGRAM* | 11/57 | 12/20 L | | | | | | | | | | 33 |
| F.240I | 355 | PROGRAM* | 12/40 L | 12/45 | 12/49 | | | | | | | | | 34 |
| F.240O | 353 | PROGRAM* | 12/33 L | 13/04 | | | | | | | | | | 35 |
| F.25 | 175 | PROGRAM* | 6/37 L | 6/42 | | | | | | | | | | 36 |
| F.26 | 206 | PROGRAM* | 7/10 L | 7/12 | | | | | | | | | | 37 |
| F.35 | 173 | PROGRAM* | 6/29 L | 6/34 | | | | | | | | | | 38 |
| F.36 | 205 | PROGRAM* | 7/06 L | 7/08 | | | | | | | | | | 39 |
| F.40 | 210 | PROGRAM* | 6/48 | 7/15 L | | | | | | | | | | 40 |
| F.90 | 212 | PROGRAM* | 7/13 | 7/23 L | | | | | | | | | | 41 |
| LENGTH | 14 | PROGRAM* | 2/54 L | 4/31 S | | | | | | | | | | 42 |
| LENGTHB | 15 | PROGRAM* | 2/55 L | 4/36 S | 11/12 | | | | | | | | | 43 |
| LOOP1 | 111 | PROGRAM* | 4/04 L | 4/10 | | | | | | | | | | 44 |
| MONE | 31 | PROGRAM* | 3/12 L | 3/26 | | | | | | | | | | 45 |
| NBB | 102 | PROGRAM* | 3/41 L | 6/11 | 6/46 | 10/33 | 12/01 S | | | | | | | 46 |
| | | | 5/27 S | 6/14 S | 9/47 | 11/55 | | | | | | | | 47 |
| NCOLM | 3 | PROGRAM* | 2/45 L | 3/57 | 4/26 | 4/52 | 7/30 | 11/44 | 12/27 | | | | | 48 |
| NCOLMM1 | 13 | PROGRAM* | 2/53 L | 4/55 S | 10/40 | | | | | | | | | 49 |
| NROW2 | 4 | PROGRAM* | 2/46 L | 4/25 | 12/20 | | | | | | | | | 50 |
| NSOLBLK | 6 | PROGRAM* | 2/48 L | 13/01 | | | | | | | | | | 51 |
| NUMBLK | 7 | PROGRAM* | 2/49 L | 6/45 | 9/46 | 11/21 | 12/21 | 12/55 | | | | | | 52 |
| NVECT | 5 | PROGRAM* | 2/47 L | 4/32 | 5/20 | 7/31 | 10/28 | 11/15 | 11/40 | 12/52 | | | | 53 |
| N.10 | 364 | PROGRAM* | 12/54 | 13/07 L | | | | | | | | | | 54 |
| N.3 | 261 | PROGRAM* | 7/37 | 8/10 | 9/12 | 9/29 L | | | | | | | | 55 |
| N.4 | 251 | PROGRAM* | 8/22 | 9/08 L | | | | | | | | | | 56 |
| N.5 | 266 | PROGRAM* | 9/33 | 9/46 L | | | | | | | | | | 57 |



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|---|---|---|---|---|---|---|---|---|---|---|---|
| N.6 | 335 | PROGRAM* | 11/36 | 11/55 L | | | | | | | |
| N.7 | 177 | PROGRAM* | 6/05 | 6/45 L | | | | | | | |
| N.8 | 273 | PROGRAM* | 9/49 | 10/01 L | | | | | | | |
| ONE | 26 | PROGRAM* | 3/09 L | 3/14 | 3/17 | | | | | | |
| PIVOT | 73 | PROGRAM* | 3/34 L | 7/41 S | 8/23 | | | | | | |
| QA(L.N) | 72 | PROGRAM* | 3/33 L | 8/04 S | 8/20 | 9/17 S | | | | | |
| QA(NHB. | 101 | PROGRAM* | 3/40 L | 10/36 S | 11/19 | 11/48 | 11/51 S | | | | |
| QA(1.I) | 75 | PROGRAM* | 3/36 L | 8/14 S | 8/25 | 9/15 | 9/18 S | | | | |
| QA(1.N) | 70 | PROGRAM* | 3/31 L | 7/28 S | 7/35 | 9/29 | 9/39 S | | | | |
| QA(1.P) | 20 | PROGRAM* | 3/02 L | 4/51 S | 6/17 | 6/52 | | | | | |
| QA(1.Z) | 12 | PROGRAM* | 2/52 L | 5/08 S | 10/32 | | | | | | |
| QA(1.1) | 16 | PROGRAM* | 2/56 L | 4/50 S | 6/16 | 7/24 | 10/02 | | | | |
| QA(2.NN | 10 | PROGRAM* | 2/50 L | 5/01 S | 10/23 | | | | | | |
| QA(2.N) | 77 | PROGRAM* | 3/38 L | 10/27 S | 10/39 | 11/43 | 11/47 S | | | | |
| QB(1.I) | 76 | PROGRAM* | 3/37 L | 7/48 S | 8/44 | 9/23 | 9/25 S | | | | |
| QB(1.L) | 100 | PROGRAM* | 3/39 L | 10/31 S | 10/43 | 11/39 S | | | | | |
| QB(1.NN | 11 | PROGRAM* | 2/51 L | 5/23 S | 10/25 | | | | | | |
| QB(1.N) | 71 | PROGRAM* | 3/32 L | 7/29 S | 7/43 | 8/47 | 9/35 | 9/38 S | | | |
| QB(1.P) | 21 | PROGRAM* | 3/04 L | 5/16 S | 6/23 | 6/56 | | | | | |
| QB(1.1) | 17 | PROGRAM* | 2/57 L | 5/13 S | 6/20 | 7/25 | 10/09 | 11/34 | 12/29 | | |
| SAVEAO | 0 | PROGRAM* | 2/42 L | 3/50 S | 13/07 | | | | | | |
| TWO | 27 | PROGRAM* | 3/10 L | 3/29 | | | | | | | |
| XF.130 | 74 | PROGRAM* | 3/35 L | 8/17 S | 9/10 | | | | | | |
| XIF.110 | 103 | PROGRAM* | 3/42 L | 8/18 S | 8/28 | 9/19 | 9/21 S | | | | |
| ZERO | 30 | PROGRAM* | 3/11 L | 3/20 | 3/23 | | | | | | |

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1                SUBROUTINE DISKIO (LU,A1,A2,N)                          DISKIO     2
           C     -1 IMPLIES BACKSPACE                                    DISKIO     3
           C     0  IMPLIES WRITE                                        DISKIO     4
           C     1  IMPLIES READ                                         DISKIO     5
5          C     2  IMPLIES REWIND                                       DISKIO     6
                 IF (N .EQ. 1) GO TO 30                                  DISKIO     7
                 IF (N) 50, 1, 60                                        DISKIO     8
               1 BUFFER OUT (LU,1) (A1,A2)                               DISKIO     9
              10 IF (UNIT(LU) ) 40,20,20                                 DISKIO    10
10            20 WRITE (6,100) LU,N                                      DISKIO    11
                 CALL EXIT                                               DISKIO    12
              30 BUFFER IN (LU,1) (A1,A2)                                DISKIO    13
                 GO TO 10                                                DISKIO    14
              40 RETURN                                                  DISKIO    15
15            50 BACKSPACE LU                                            DISKIO    16
                 GO TO 40                                                DISKIO    17
              60 REWIND LU                                               DISKIO    18
                 GO TO 40                                                DISKIO    19
           C                                                             DISKIO    20
20           100 FORMAT (19H0BUFFER ERROR, UNIT      ,I5,5X,2HN=   I5)    DISKIO    21
                 END                                                     DISKIO    22
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92500

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      OVERLAY ( FILE0, 3, 5 )                                                    STRESS     2
      PROGRAM STRESS                                                             STRESS     3
      COMMON NODES,NELEM,E(720),PR(720),TH(720),X(400,3),NB(720,3),NODIS         STRESS     4
     1(400,6),BC(400,6),COMT(13),RPMX,RPMY,RPMZ,GAMMA,SPACE(18624)               STRESS     5
      COMMON /ARRAYS/ R(3,3),FK(9,9),T(9,9),S(18,18),SL(18,18),V(9,9)            STRESS     6
      COMMON/SPECL/ KSPEC(400)                                                   STRESS     7
      COMMON / COUNT / KOUNTER, MFLAGF, OLDTFT, TOLERC                           STRESS     8
      COMMON / DISPL / DISPL(400,3),NG                                           STRESS     9
      COMMON/THERML/ TMPT(720),TMPB(720),ALPHAT(720)                             STRESS    10
      COMMON/KGCALC/KKPASS,STGX(720),STGY(720),TAUXY(720)                        STRESS    11
      DIMENSION GSPACE (6,400)                                                   STRESS    12
      EQUIVALENCE (GSPACE,SPACE(9312) )                                          STRESS    13
      KOUNT=0                                                                    STRESS    14
      DO 80 N=1,NELEM                                                            STRESS    15
      IF (KKPASS.EQ.0) GO TO 10                                                  STRESS    16
      KOUNT=KOUNT+1                                                              STRESS    17
      IF (KOUNT.NE.1) GO TO 10                                                   STRESS    18
      WRITE (6,120) COMT                                                         STRESS    19
      WRITE (6,90)                                                               STRESS    20
   10 N1=IABS(NB(N,1))                                                           STRESS    21
      NB(N,1)=N1                                                                 STRESS    22
      N2=NB(N,2)                                                                 STRESS    23
      N3=NB(N,3)                                                                 STRESS    24
      EX=E(N)                                                                    STRESS    25
      EIA=PR(N)                                                                  STRESS    26
      X1=X(N1,1)                                                                 STRESS    27
      Y1=X(N1,2)                                                                 STRESS    28
      Z1=X(N1,3)                                                                 STRESS    29
      X2=X(N2,1)                                                                 STRESS    30
      Y2=X(N2,2)                                                                 STRESS    31
      Z2=X(N2,3)                                                                 STRESS    32
      X3=X(N3,1)                                                                 STRESS    33
      Y3=X(N3,2)                                                                 STRESS    34
      Z3=X(N3,3)                                                                 STRESS    35
      THICK=TH(N)                                                                STRESS    36
      XM=(X1+X2+X3)/3.                                                           STRESS    37
      YM=(Y1+Y2+Y3)/3.                                                           STRESS    38
      ZM=(Z1+Z2+Z3)/3.                                                           STRESS    39
      I=1                                                                        STRESS    40
      J=1                                                                        STRESS    41
      K=N1                                                                       STRESS    42
   20 L=(K-1)*6+1                                                                STRESS    43
      DO 30 M=1,6                                                                STRESS    44
      S(J)=SPACE(L)                                                              STRESS    45
      J=J+1                                                                      STRESS    46
   30 L=L+1                                                                      STRESS    47
      IF (I-2) 40,50,60                                                          STRESS    48
   40 I=2                                                                        STRESS    49
      K=N2                                                                       STRESS    50
      GO TO 20                                                                   STRESS    51
   50 I=3                                                                        STRESS    52
      K=N3                                                                       STRESS    53
      GO TO 20                                                                   STRESS    54
   60 CALL TRISTR (N,GSPACE)                                                     STRESS    55
      IF (KKPASS.EQ.0) GO TO 80                                                  STRESS    56
      DO 70 I=1,16                                                               STRESS    57
      IF (I.EQ.6.OR.I.EQ.13) GO TO 70                                            STRESS    58
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82500

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                S(I)=S(I)*.001                                                  STRESS      59
             70 CONTINUE                                                        STRESS      60
60              WRITE (6,100) N,XM,YM,ZM,(S(I),I=1,16)                          STRESS      61
                IF (KOUNT.GT.49) KOUNT=0                                        STRESS      62
C               SAVE PRINCIPAL AND EQUIVALENT STRESSES FOR PLOTTING             STRESS      63
                SIGX(N)= S(4)                                                   STRESS      64
                SIGY(N)= S(5)                                                   STRESS      65
65              TAUXY(N)=S(7)                                                   STRESS      66
                E(N)=  S(11)                                                    STRESS      67
                PR(N)= S(12)                                                    STRESS      68
                TH(N)= S(14)                                                    STRESS      69
                IF (NG .EQ. 3) GO TO 80                                         STRESS      70
70              CALCULATE RADIAL STRESSES                                       STRESS      71
                X1= X(N1,1)                                                     STRESS      72
                Y1= X(N1,2)                                                     STRESS      73
                Z1= X(N1,3)                                                     STRESS      74
                X2= X(N2,1) - X1                                                STRESS      75
75              Y2= X(N2,2) - Y1                                                STRESS      76
                Z2= X(N2,3) - Z1                                                STRESS      77
                XM= SQRT( X2**2 + Y2**2 + Z2**2 )                               STRESS      78
                IF (NG .EQ. 1 .OR. NG .EQ. 8) GO TO 71                          STRESS      79
                X1= 0.                                                          STRESS      80
80              GO TO 72                                                        STRESS      81
             71 Z1= 0.                                                          STRESS      82
             72 YM= SQRT (X1**2 + Y1**2 + Z1**2 )                               STRESS      83
                ZM= X1 * X2 + Y1 * Y2 + Z1 * Z2                                 STRESS      84
                X3= ZM / XM / YM                                                STRESS      85
85              IF (ABS(X3) .GT. 1. ) X3= SIGN (1., X3 )                        STRESS      86
                Y3= SQRT (1. - X3**2)                                           STRESS      87
                EX= ATAN2 (Y3,X3)                                               STRESS      88
                X3= EX - S(6) * .0174533                                        STRESS      89
                Y3= SIN(X3)**2                                                  STRESS      90
90              TMPT (N)= S(4) * (1. - Y3) + S(5) * Y3                          STRESS      91
                X3= EX - S(13) * .0174533                                       STRESS      92
                Y3= SIN(X3)**2                                                  STRESS      93
                TMPB (N)= S(11) * (1. - Y3) + S(12) * Y3                        STRESS      94
             80 CONTINUE                                                        STRESS      95
95              IF (KKPASS .EQ. 0) GO TO 86                                     STRESS      96
                WRITE (6,110)                                                   STRESS      97
                IF (NG .EQ. 3) GO TO 800                                        STRESS      98
                WRITE (6,120) COMT                                              STRESS      99
                WRITE (6,240)                                                   STRESS     100
100             DO 850 I=1,NELEM,7                                              STRESS     101
                J= I + 6                                                        STRESS     102
                IF (J .GT. NELEM) J= NELEM                                      STRESS     103
            850 WRITE (6,250) (N, TMPT(N), TMPB(N), N=I,J)                      STRESS     104
                WRITE (6,110)                                                   STRESS     105
105             WRITE (6,260)                                                   STRESS     106
            800 CONTINUE                                                        STRESS     107
                KOUNT=0                                                         STRESS     108
                DO 85 I=1,NODES                                                 STRESS     109
                IF (KSPEC(I) .EQ. 0) GO TO 85                                   STRESS     110
110             KOUNT=KOUNT+1                                                   STRESS     111
                IF (KOUNT .NE. 1) GO TO 81                                      STRESS     112
                WRITE (6,120) COMT                                              STRESS     113
                WRITE (6,140)                                                   STRESS     114
                WRITE (6,220)                                                   STRESS     115
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      PI WRITE (6,230) I,(GSPACE(L,I),L=1,6)                                  STRESS   116
         IF (KOUNT .GT. 49) KOUNT=0                                           STRESS   117
      85 CONTINUE                                                             STRESS   118
C     SAVE DEFLECTIONS                                                        STRESS   119
      86 DO 89 I=1,NODES                                                      STRESS   120
         K= (I-1)*6                                                           STRESS   121
         L=0                                                                  STRESS   122
         IF (KSPEC(I) .NE. 0) L=1                                             STRESS   123
         DO 88 J=1,3                                                          STRESS   124
         IF (L .EQ. 0) GO TO 87                                               STRESS   125
         DISP1(I,J)= GSPACE(J,I)                                              STRESS   126
         GO TO 88                                                             STRESS   127
      87 DISP1(I,J)=  SPACE(K+J)                                              STRESS   128
      88 CONTINUE                                                             STRESS   129
      89 CONTINUE                                                             STRESS   130
         IF (KKPASS .EQ. 0) GO TO 130                                         STRESS   131
C     PICK UP PREVIOUS Z-DISPLACEMENTS FROM TAPE 65                           STRESS   132
      REWIND 65                                                               STRESS   133
 4000 READ (65,230) I, SPACE(I)                                               STRESS   134
      IF (EOF(65)) 4010,4000                                                  STRESS   135
 4010 REWIND 65                                                               STRESS   136
C **  CHECK FOR CONVERGENCE                                                   STRESS   137
      MFLAGZ= 0                                                               STRESS   138
      ORELAX= 1. - RELAX                                                      STRESS   139
      DUMM= 0.                                                                STRESS   140
      DO 4110 I=1,NODES                                                       STRESS   141
      DUM= SPACE(I) - DISP1(I,3)                                              STRESS   142
      IF ( DUM .EQ. 0.) GO TO 4050                                            STRESS   143
C     NOTE THAT SPACE VALUES HAVE BEEN ROUNDED TO 8 PLACES                    STRESS   144
      IF (ABS(DUM) .LT. .00001 ) GO TO 4050                                   STRESS   145
      IF ( SPACE(I) .EQ. 0.) GO TO 4020                                       STRESS   146
      DUM= DUM / SPACE(I)                                                     STRESS   147
      GO TO 4030                                                              STRESS   148
 4020 DUM= DUM / DISP1(I,3)                                                   STRESS   149
 4030 IF ( ABS(DUM) .GT. TOLERC ) MFLAGZ= 1                                   STRESS   150
      DUMM = AMAX1 ( DUMM, ABS(DUM) )                                         STRESS   151
 4050 DUM= DISP1(I,3) * RELAX + SPACE(I) * ORELAX                             STRESS   152
 4110 WRITE (65,230) I, DUM                                                   STRESS   153
      IF ( MFLAGZ .NE. 0 .OR. MFLAGF .EQ. 0 ) GO TO 4100                      STRESS   154
      WRITE (6,3000) TOLERC                                                   STRESS   155
 3000 FORMAT (17H0CONVERGED WITHIN  , 2PF6.2  , 9H PERCENT  )                 STRESS   156
      CALL EXIT                                                               STRESS   157
C     NOT YET CONVERGED                                                       STRESS   158
 4100 REWIND 65                                                               STRESS   159
      WRITE (6,3010)  MFLAGF, DUMM                                            STRESS   160
 3010 FORMAT (22H0 * * TAPE65 REWRITTEN  ,2GX, I2, F10.4 )                    STRESS   161
      KOUNTER= KOUNTER + 1                                                    STRESS   162
C                                                                             STRESS   163
   90 FORMAT (1H0,4X,17HCENTER OF ELEMENT,22X,65HSTRESSES ARE CALCULATED      STRESS   164
     1 IN THE LOCAL (ELEMENT) COORDINATE SYSTEM /6X,16H(GLOBAL COORDS) ,      STRESS   165
     22(49H (----------------  AT Z=  T/2  ----------------)),12H(--AT Z      STRESS   166
     3=0--)/1H+,47X,1H+,48X,1H+/1X,4HELEM,4X,1HX,5X,1HY,5X,1HZ,2(2X,47HS      STRESS   167
     4IG X  SIG Y TAU XY    MAX    MIN  ANGLE EQUIV.),12H TAUXZ TAUYZ)        STRESS   168
  100 FORMAT (1X,I3,3F6.3,14F7.1,(2F6.1))                                     STRESS   169
  110 FORMAT (35H0STRESSES IN KSI, ANGLES IN DEGREES)                         STRESS   170
  120 FORMAT (1H1,13A6)                                                       STRESS   171
  130 CONTINUE                                                                STRESS   172
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      140 FORMAT (38H0FOR NODES PREVIOUSLY MARKED **LOCAL**      )            STRESS    173
      220 FORMAT (50H0GLOBAL DEFLECTIONS (IN) AND ROTATIONS (RADIANS)--/6H0  STRESS    174
     1NODE,7X,2HUX,13X,2HUY,13X,2HUZ,13X,7HTHETA X,8X,7HTHETA Y,8X,7HTHE    STRESS    175
     2TA Z      )                                                           STRESS    176
  175 230 FORMAT ( 1X, I5,F14.8, 5F15.8 )                                   STRESS    177
      240 FORMAT (1H0,7(5X,6HZ=+T/2,1X,6HZ=-T/2) / 1X,7(18H ELM  SIG R  SIG  STRESS    178
     1R  )     )                                                           STRESS    179
      250 FORMAT (1X,7(I4,2F7.1))                                           STRESS    180
  180 260 FORMAT (44H0NOTE-- ASSUMES ELEMENT IS RADIALLY ORIENTED      )     STRESS    181
          END                                                               STRESS    182
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      SUBROUTINE TRISTR (N,GSPACE)                                          TRISTR     2
      COMMON /PARAM/ E,ETA,X1,Y1,Z1,X2,Y2,Z2,X3,Y3,Z3,TH                    TRISTR     3
      COMMON /ARRAYS/ R(3,3),FK(9,9),T(9,9),S(18,18),SL(18,18),V(9,9)       TRISTR     4
      COMMON /KGCALC/ KKPASS,SIGX(720),SIGY(720),TAUXY(720)                 TRISTR     5
      COMMON /THERML /TMPT (720),TMPB(720),ALPHAT(720)                      TRISTR     6
      COMMON/SPECL/ KSPEC(400)                                              TRISTR     7
      COMMON/ TRI / N1,N2,N3                                                TRISTR     8
      DIMENSION GSPACE (6,400)                                              TRISTR     9
      DIMENSION RR(3,3)                                                     TRISTR    10
      DIMENSION U(18), UL(18), UP(6), UB(9), STRESS(16)                     TRISTR    11
      EQUIVALENCE (U,S), (UL,SL), (UP,SL(20)), (UB,SL(30)), (STRESS,S)      TRISTR    12
C     FORM STRESS COEFF. MATRIX FOR BENDING                                 TRISTR    13
      DIMENSION H(9,6)                                                      TRISTR    14
      EQUIVALENCE (H,FK)                                                    TRISTR    15
      BETA=(1.-ETA)*.5                                                      TRISTR    16
      D=E*TH**3/12./(1.-ETA**2)                                             TRISTR    17
C     CALC. ROTATION MATRIX R.  (XG,YG,ZG)T = R* (XL,YL,ZL)T, R*(R)T= I.    TRISTR    18
      X21=X2-X1                                                             TRISTR    19
      Y21=Y2-Y1                                                             TRISTR    20
      Z21=Z2-Z1                                                             TRISTR    21
      X31=X3-X1                                                             TRISTR    22
      Y31=Y3-Y1                                                             TRISTR    23
      Z31=Z3-Z1                                                             TRISTR    24
      TEMP=SQRT(X21**2+Y21**2+Z21**2)                                       TRISTR    25
      R(1,1)=X21/TEMP                                                       TRISTR    26
      R(2,1)=Y21/TEMP                                                       TRISTR    27
      R(3,1)=Z21/TEMP                                                       TRISTR    28
      TEMPA=Y21*Z31-Y31*Z21                                                 TRISTR    29
      TEMPB=X31*Z21-X21*Z31                                                 TRISTR    30
      TEMPC=X21*Y31-X31*Y21                                                 TRISTR    31
      TEMP=SQRT(TEMPA**2+TEMPB**2+TEMPC**2)                                 TRISTR    32
      R(1,3)=TEMPA/TEMP                                                     TRISTR    33
      R(2,3)=TEMPB/TEMP                                                     TRISTR    34
      R(3,3)=TEMPC/TEMP                                                     TRISTR    35
      R(1,2)=R(2,3)*R(3,1)-R(3,3)*R(2,1)                                    TRISTR    36
      R(2,2)=R(3,3)*R(1,1)-R(1,3)*R(3,1)                                    TRISTR    37
      R(3,2)=R(1,3)*R(2,1)-R(2,3)*R(1,1)                                    TRISTR    38
C     TRANSFORM COORDINATES TO LOCAL SYSTEM.  SET A,B,C DIMENSIONS.         TRISTR    39
      X11=R(1,1)*X1+R(2,1)*Y1+R(3,1)*Z1                                     TRISTR    40
      X21=R(1,1)*X2+R(2,1)*Y2+R(3,1)*Z2                                     TRISTR    41
      X31=R(1,1)*X3+R(2,1)*Y3+R(3,1)*Z3                                     TRISTR    42
      A=X21-X31                                                             TRISTR    43
      B=X31-X11                                                             TRISTR    44
      Y11=R(1,2)*X1+R(2,2)*Y1+R(3,2)*Z1                                     TRISTR    45
      Y21=R(1,2)*X2+R(2,2)*Y2+R(3,2)*Z2                                     TRISTR    46
      Y31=R(1,2)*X3+R(2,2)*Y3+R(3,2)*Z3                                     TRISTR    47
      C=Y31-Y11                                                             TRISTR    48
C     TRANSLATE TO C.G. OF TRIANGLE TO CODE BENDING MATRIX                  TRISTR    49
      TEMP=(X11+X21+X31)/3.                                                 TRISTR    50
      X1=X11-TEMP                                                           TRISTR    51
      X2=X21-TEMP                                                           TRISTR    52
      X3=X31-TEMP                                                           TRISTR    53
      TEMP=(Y11+Y21+Y31)/3.                                                 TRISTR    54
      Y1=Y11-TEMP                                                           TRISTR    55
      Y2=Y21-TEMP                                                           TRISTR    56
      Y3=Y31-TEMP                                                           TRISTR    57
      TWODEL=C*(A+B)                                                        TRISTR    58
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                IF (KKPASS.EQ.0) GO TO 80                                TRISTR     59
                A1=TWODEL/3.                                             TRISTR     60
60          C   FORM T. IGNORE CONSTANT FACTOR FOR NOW                    TRISTR     61
                DO 20 I=1,81                                             TRISTR     62
             20 T(I)=0.                                                  TRISTR     63
                T(1,1)=A                                                 TRISTR     64
                T(3,1)=A                                                 TRISTR     65
65              T(5,1)=A                                                 TRISTR     66
                T(2,1)=-C                                                TRISTR     67
                T(4,1)=-C                                                TRISTR     68
                T(6,1)=-C                                                TRISTR     69
                T(1,2)=TWODEL                                            TRISTR     70
70              T(2,3)=TWODEL                                            TRISTR     71
                T(3,5)=TWODEL                                            TRISTR     72
                T(4,6)=TWODEL                                            TRISTR     73
                T(5,8)=TWODEL                                            TRISTR     74
                T(6,9)=TWODEL                                            TRISTR     75
75              T(1,4)=B                                                 TRISTR     76
                T(3,4)=B                                                 TRISTR     77
                T(5,4)=B                                                 TRISTR     78
                T(2,4)=C                                                 TRISTR     79
                T(4,4)=C                                                 TRISTR     80
80              T(6,4)=C                                                 TRISTR     81
                T(1,7)=-(A+B)                                            TRISTR     82
                T(3,7)=T(1,7)                                            TRISTR     83
                T(5,7)=T(1,7)                                            TRISTR     84
            C   FORM H.                                                  TRISTR     85
85              TEMP=A+B                                                 TRISTR     86
                CON1=-C**2                                               TRISTR     87
                CON2=A*B-TEMP**2                                         TRISTR     88
                CON5=-2.*C                                               TRISTR     89
                CON6=-A-2.*B                                             TRISTR     90
90              CON7=2.*A+B                                              TRISTR     91
                CON8=B-A                                                 TRISTR     92
                CON9=2.*C**2                                             TRISTR     93
                CON12=2.*A**2                                            TRISTR     94
                CON13=2.*B**2                                            TRISTR     95
95              CON14=2.*TEMP**2                                         TRISTR     96
                H(1,1)=A1*C**3                                           TRISTR     97
                H(1,3)=H(1,1)                                            TRISTR     98
                H(1,5)=2.*H(1,1)                                         TRISTR     99
                H(4,2)=A1*CON6*(CON2+CON12)                              TRISTR    100
100             H(4)=A1*CON7*(CON2+CON13)                                TRISTR    101
                H(4,6)=A1*CON8*(CON2+CON14)                              TRISTR    102
                TEMPA=4.*A*TWODEL                                        TRISTR    103
                TEMPB=4.*B*TWODEL                                        TRISTR    104
                TEMPC=4.*C*TWODEL                                        TRISTR    105
105             TEMPD=4.*TEMP*TWODEL                                     TRISTR    106
                H(4,1)=A1*(C*(CON2+CON12)-TEMPA)                         TRISTR    107
                H(4,3)=A1*(C*(CON2+CON13)-TEMPB)                         TRISTR    108
                H(4,5)=A1*(CON5*(CON2+CON14)+TEMPD)                      TRISTR    109
                H(1,2)=A1*(-CON6*CON1+TEMPC)                             TRISTR    110
110             H(1,4)=A1*(-CON7*CON1-TEMPC)                             TRISTR    111
                H(1,6)=A1*CON8*CON1                                      TRISTR    112
                CON2=3.*A*B*TEMP                                         TRISTR    113
                H(2,1)=0.                                                TRISTR    114
                H(2,3)=0.                                                TRISTR    115
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                H(2,5)=0.                                                       TRISTR  116
                H(6,2)=CON2*CON6                                                TRISTR  117
                H(6,4)=CON2*CON7                                                TRISTR  118
                H(6,6)=CON2*CON8                                                TRISTR  119
                H(2,2)=-3.*CON9*TWODEL                                          TRISTR  120
                H(2,4)=H(2,2)                                                   TRISTR  121
                H(2,6)=0.                                                       TRISTR  122
                H(6,1)=CON2*C+3.*CON12*TWODEL                                   TRISTR  123
                H(6,3)=CON2*C+3.*CON13*TWODEL                                   TRISTR  124
                H(6,5)=CON2*CON5+3.*CON14*TWODEL                                TRISTR  125
                CON1=C*CON8                                                     TRISTR  126
                CON15=4.*A*C                                                    TRISTR  127
                CON16=-4.*B*C                                                   TRISTR  128
                CON18=CON15*TWODEL                                              TRISTR  129
                CON19=CON16*TWODEL                                              TRISTR  130
                H(7,2)=A1*(CON6*(CON1+CON15)+TEMPA)                             TRISTR  131
                H(7,4)=A1*(CON7*(CON1+CON16)+TEMPB)                             TRISTR  132
                H(7,6)=A1*(CON8*CON1-TEMPD)                                     TRISTR  133
                H(7,1)=A1*(C*(CON1+CON15)-TEMPC)                                TRISTR  134
                H(7,3)=A1*(C*(CON1+CON16)+TEMPC)                                TRISTR  135
                H(7,5)=A1*CON5*CON1                                             TRISTR  136
                CON1=CON1*TEMP                                                  TRISTR  137
                CON2=-C**2*TEMP                                                 TRISTR  138
                H(5,2)=CON6*CON1-CON12*TWODEL                                   TRISTR  139
                H(5,4)=CON7*CON1-CON13*TWODEL                                   TRISTR  140
                H(5,6)=CON8*CON1-CON14*TWODEL                                   TRISTR  141
                H(3,1)=C*CON2+CON9*TWODEL                                       TRISTR  142
                H(3,3)=H(3,1)                                                   TRISTR  143
                H(3,5)=CON5*CON2                                                TRISTR  144
                H(5,1)=C*CON1+CON18                                             TRISTR  145
                H(5,3)=C*CON1+CON19                                             TRISTR  146
                H(5,5)=CON5*CON1                                                TRISTR  147
                H(3,2)=CON6*CON2-CON18                                          TRISTR  148
                H(3,4)=CON7*CON2-CON19                                          TRISTR  149
                H(3,6)=CON8*CON2                                                TRISTR  150
                L=3                                                             TRISTR  151
                DO 40 J=8,9                                                     TRISTR  152
                DO 30 I=1,6                                                     TRISTR  153
             30 H(J,I)=H(L,I)*2.                                                TRISTR  154
             40 L=5                                                             TRISTR  155
          C     FORM Z.    STORE IN V                                          TRISTR  156
                DO 50 J=1,6                                                     TRISTR  157
                V(1,J)=FK(2,J)+ETA*FK(5,J)+BETA*FK(9,J)                         TRISTR  158
                V(2,J)=FK(6,J)+ETA*FK(3,J)+BETA*FK(8,J)                         TRISTR  159
                V(3,J)=FK(1,J)+ETA*FK(4,J)                                      TRISTR  160
                V(4,J)=FK(4,J)+ETA*FK(1,J)                                      TRISTR  161
             50 V(5,J)=FK(7,J)*BETA                                             TRISTR  162
          C     FORM Z*T AND STORE IN FK                                        TRISTR  163
                CON1=-D/TWODEL**4                                               TRISTR  164
                DO 70 I=1,5                                                     TRISTR  165
                DO 70 J=1,9                                                     TRISTR  166
                SUM=0.                                                          TRISTR  167
                DO 60 K=1,6                                                     TRISTR  168
             60 SUM=SUM+V(I,K)*T(K,J)                                           TRISTR  169
             70 FK(I,J)=SUM*CON1                                                TRISTR  170
          C     CONVERT GLOBAL DEFLECTIONS TO LOCAL SYSTEM                      TRISTR  171
             80 DO 90 I=1,16,3                                                  TRISTR  172
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                J=I+1                                                          TRISTR  173
                K=J+1                                                          TRISTR  174
          C     CHECK IF NODAL DEFLECTIONS ARE ALREADY IN LOCAL SYSTEM          TRISTR  175
      175       IF (I - 7) 85,87,82                                            TRISTR  176
           82   IF (I .EQ. 10) GO TO 87                                        TRISTR  177
                GO TO 88                                                       TRISTR  178
           85   L=N1                                                           TRISTR  179
                KL= 1                                                          TRISTR  180
      180       86 IF (KSPEC(L) .EQ. 0) GO TO 81                               TRISTR  181
                IF (KSPEC(L) .NE. N) GO TO 83                                  TRISTR  182
                UL(I)=U(I)                                                     TRISTR  183
                UL(J)= U(J)                                                    TRISTR  184
                UL(K)= U(K)                                                    TRISTR  185
      185       IF (KL .NE. 1 .AND. KKPASS .EQ. 0) GO TO 90                    TRISTR  186
          C     CALC GLOBAL COORDINATES FOR SPECIAL NODE                       TRISTR  187
                CALL ABC (R, U(I), GSPACE(KL,L) )                              TRISTR  188
                GO TO 90                                                       TRISTR  189
          C     CALC GLOBAL COORDS FOR SPECIAL NODE, THEN TRANSFORM TO LOCAL   TRISTR  190
      190       83 CALL RCALC(RR,KSPEC(L))                                     TRISTR  191
                CALL ABC (RR,U(I),GSPACE(KL,L))                                TRISTR  192
                U(I) = GSPACE (KL,L)                                           TRISTR  193
                U(J)= GSPACE (KL+1,L)                                          TRISTR  194
                U(K)= GSPACE (KL+2,L)                                          TRISTR  195
      195       GO TO 81                                                       TRISTR  196
           87   L=N2                                                           TRISTR  197
                KL= I-6                                                        TRISTR  198
                GO TO 86                                                       TRISTR  199
           88   L= N3                                                          TRISTR  200
      200       KL= I-12                                                       TRISTR  201
                GO TO 86                                                       TRISTR  202
           81   UL(I)=R(1,1)*U(I)+R(2,1)*U(J)+R(3,1)*U(K)                      TRISTR  203
                UL(J)=R(1,2)*U(I)+R(2,2)*U(J)+R(3,2)*U(K)                      TRISTR  204
                UL(K)=R(1,3)*U(I)+R(2,3)*U(J)+R(3,3)*U(K)                      TRISTR  205
      205       90 CONTINUE                                                    TRISTR  206
          C     SEPARATE LOCAL DEFLECTIONS INTO INPLANE AND BENDING            TRISTR  207
                J=1                                                            TRISTR  208
                K=1                                                            TRISTR  209
                DO 100 I=1,13,6                                                TRISTR  210
      210       UP(J)=UL(I)                                                    TRISTR  211
                J=J+1                                                          TRISTR  212
                UP(J)=UL(I+1)                                                  TRISTR  213
                J=J+1                                                          TRISTR  214
                IF (KKPASS.EQ.0) GO TO 100                                     TRISTR  215
      215       UB(K)=UL(I+2)                                                  TRISTR  216
                K=K+1                                                          TRISTR  217
                UB(K)=UL(I+3)                                                  TRISTR  218
                K=K+1                                                          TRISTR  219
                UB(K)=UL(I+4)                                                  TRISTR  220
      220       K=K+1                                                          TRISTR  221
          100 CONTINUE                                                         TRISTR  222
                IF (KKPASS.EQ.0) GO TO 130                                     TRISTR  223
          C     CALC. NXZ,NYZ,MX,MY,MXY.    STORE IN SL(1) THROUGH SL(5)       TRISTR  224
                DO 120 I=1,5                                                   TRISTR  225
      225       SUM=0.                                                         TRISTR  226
                DO 110 J=1,9                                                   TRISTR  227
          110   SUM=SUM+FK(I,J)*UB(J)                                          TRISTR  228
          120   SL(I)=SUM                                                      TRISTR  229
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                C     SUBTRACT INITIAL THERMAL STRESS                                   TRISTR   230
230                   CON1=D*(1.+ETA)*ALPHAT(N)*(TMPT(N)-TMPB(N))/TH                    TRISTR   231
                      SL(3)=SL(3)-CON1                                                  TRISTR   232
                      SL(4)=SL(4)-CON1                                                  TRISTR   233
                C     FORM STRESS COEFFICIENT MATRIX FOR INPLANE                        TRISTR   234
                  130 V(1,1)=-C                                                         TRISTR   235
235                   V(1,2)=-ETA*A                                                     TRISTR   236
                      V(1,3)=C                                                          TRISTR   237
                      V(1,4)=-ETA*B                                                     TRISTR   238
                      V(1,5)=0.                                                         TRISTR   239
                      TEMP=A+B                                                          TRISTR   240
240                   V(1,6)=ETA*TEMP                                                   TRISTR   241
                      V(2,1)=ETA*V(1,1)                                                 TRISTR   242
                      V(2,2)=-A                                                         TRISTR   243
                      V(2,3)=ETA*C                                                      TRISTR   244
                      V(2,4)=-B                                                         TRISTR   245
245                   V(2,5)=0.                                                         TRISTR   246
                      V(2,6)=TEMP                                                       TRISTR   247
                      V(3,1)=-A*BETA                                                    TRISTR   248
                      V(3,2)=-C*BETA                                                    TRISTR   249
                      V(3,3)=-B*BETA                                                    TRISTR   250
250                   V(3,4)=-V(3,2)                                                    TRISTR   251
                      V(3,5)=TEMP*BETA                                                  TRISTR   252
                      V(3,6)=0.                                                         TRISTR   253
                      CON1=12./TWODEL/TH**2*D                                           TRISTR   254
                C     CALC. NX, NY, NXY,    STORE IN T(1) THROUGH T(3)                  TRISTR   255
255                   DO 150 I=1,3                                                      TRISTR   256
                      SUM=0.                                                            TRISTR   257
                      DO 140 J=1,6                                                      TRISTR   258
                  140 SUM=SUM+V(I,J)*UP(J)                                              TRISTR   259
                  150 T(I)=SUM*CON1                                                     TRISTR   260
260             C     SUBTRACT INITIAL THERMAL STRESSES                                 TRISTR   261
                      CON1=CON1*TWODEL*(1.+ETA)*ALPHAT(N)*((TMPT(N)+TMPB(N))*.5-70.)    TRISTR   262
                      T(1)=T(1)-CON1                                                    TRISTR   263
                      T(2)=T(2)-CON1                                                    TRISTR   264
                      IF (KKPASS.EQ.0) GO TO 160                                        TRISTR   265
265                   CON1=6./TH**2                                                     TRISTR   266
                C     CALC. SIG X,SIG Y,TAU XY,MAX,MIN,ANGLE,EQUIV, AT TOP AND BOTTOM   TRISTR   267
                      STRESS(1)=T(1)/TH+SL(3)*CON1                                      TRISTR   268
                      STRESS(2)=T(2)/TH+SL(4)*CON1                                      TRISTR   269
                      STRESS(3)=T(3)/TH+SL(5)*CON1                                      TRISTR   270
270                   CON2=(STRESS(1)+STRESS(2))*.5                                     TRISTR   271
                      CON3=SQRT((STRESS(1)-STRESS(2))**2/4.+STRESS(3)**2)               TRISTR   272
                      STRESS(4)=CON2+CON3                                               TRISTR   273
                      STRESS(5)=CON2-CON3                                               TRISTR   274
                      CON19=STRESS(1)-STRESS(2)                                         TRISTR   275
275                   STRESS(6)=0.                                                      TRISTR   276
                      IF (STRESS(3).NE.0..OR.CON19.NE.0.) STRESS(6)=28.64789*ATAN2(2.*ST TRISTR   277
                     1RESS(3),CON19)                                                    TRISTR   278
                      STRESS(7)=SQRT(STRESS(4)**2+STRESS(5)**2-STRESS(4)*STRESS(5))     TRISTR   279
                C     AT BOTTOM                                                         TRISTR   280
280                   STRESS(8)=T(1)/TH-SL(3)*CON1                                      TRISTR   281
                      STRESS(9)=T(2)/TH-SL(4)*CON1                                      TRISTR   282
                      STRESS(10)=T(3)/TH-SL(5)*CON1                                     TRISTR   283
                      CON2=(STRESS(8)+STRESS(9))*.5                                     TRISTR   284
                      CON3=SQRT((STRESS(8)-STRESS(9))**2/4.+STRESS(10)**2)              TRISTR   285
285                   STRESS(11)=CON2+CON3                                              TRISTR   286
```



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      STRESS(12)=CON2-CON3                                                    TRISTR   287
      CON19=STRESS(8)-STRESS(9)                                               TRISTR   288
      STRESS(13)=0.                                                           TRISTR   289
      IF (STRESS(10).NE.0..OR.CON19.NE.0.) STRESS(13)=28.64789*ATAN2(2.*      TRISTR   290
     1STRESS(10),CON19)                                                       TRISTR   291
      STRESS(14)=SQRT(STRESS(11)**2+STRESS(12)**2-STRESS(11)*STRESS(12))      TRISTR   292
C     CALC. TAU XZ AND TAU YZ AT CENTER OF PLATE                              TRISTR   293
      STRESS(15)=SL(1)*1.5/TH                                                 TRISTR   294
      STRESS(16)=SL(2)*1.5/TH                                                 TRISTR   295
      GO TO 170                                                               TRISTR   296
  160 SIGX(N)=T(1)/TH                                                         TRISTR   297
      SIGY(N)=T(2)/TH                                                         TRISTR   298
      TAUXY(N)=T(3)/TH                                                        TRISTR   299
  170 RETURN                                                                  TRISTR   300
      END                                                                     TRISTR   301
```



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```
      SUBROUTINE RCALC (R,N)                                                RCALC      2
      COMMON NODES,NELEM,E(720),PR(720),TH(720),X(400,3),NB(720,3),NODIS    RCALC      3
     1(400,6),RC(400,6),COMT(13),RPMX,RPMY,RPMZ,GAMMA,B(192),A(192,96)      RCALC      4
      DIMENSION R(3,3)                                                      RCALC      5
      N1=IABS(NB(N,1))                                                      RCALC      6
      N2=NB(N,2)                                                            RCALC      7
      N3=NB(N,3)                                                            RCALC      8
      X1=X(N1,1)                                                            RCALC      9
      Y1=X(N1,2)                                                            RCALC     10
      Z1=X(N1,3)                                                            RCALC     11
      X2=X(N2,1)                                                            RCALC     12
      Y2=X(N2,2)                                                            RCALC     13
      Z2=X(N2,3)                                                            RCALC     14
      X3=X(N3,1)                                                            RCALC     15
      Y3=X(N3,2)                                                            RCALC     16
      Z3=X(N3,3)                                                            RCALC     17
      X21=X2-X1                                                             RCALC     18
      Y21=Y2-Y1                                                             RCALC     19
      Z21=Z2-Z1                                                             RCALC     20
      X31=X3-X1                                                             RCALC     21
      Y31=Y3-Y1                                                             RCALC     22
      Z31=Z3-Z1                                                             RCALC     23
      TEMP=SQRT(X21**2+Y21**2+Z21**2)                                       RCALC     24
      IF (TEMP.EQ.0.) GO TO 250                                             RCALC     25
      R(1,1)=X21/TEMP                                                       RCALC     26
      R(2,1)=Y21/TEMP                                                       RCALC     27
      R(3,1)=Z21/TEMP                                                       RCALC     28
      TEMPA=Y21*Z31-Y31*Z21                                                 RCALC     29
      TEMPB=X31*Z21-X21*Z31                                                 RCALC     30
      TEMPC=X21*Y31-X31*Y21                                                 RCALC     31
      TEMP=SQRT(TEMPA**2+TEMPB**2+TEMPC**2)                                 RCALC     32
      IF (TEMP.EQ.0.) GO TO 250                                             RCALC     33
      R(1,3)=TEMPA/TEMP                                                     RCALC     34
      R(2,3)=TEMPB/TEMP                                                     RCALC     35
      R(3,3)=TEMPC/TEMP                                                     RCALC     36
      R(1,2)=R(2,3)*R(3,1)-R(3,3)*R(2,1)                                    RCALC     37
      R(2,2)=R(3,3)*R(1,1)-R(1,3)*R(3,1)                                    RCALC     38
      R(3,2)=R(1,3)*R(2,1)-R(2,3)*R(1,1)                                    RCALC     39
      RETURN                                                                RCALC     40
  250 WRITE (6,270) N                                                       RCALC     41
  270 FORMAT (16H0BAD ELEMENT NO.I5,6H RCALC    )                           RCALC     42
      CALL EXIT                                                             RCALC     43
      END                                                                   RCALC     44
```

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```
1                SUBROUTINE ABC (A,B,C)
                 DIMENSION A(3,3), B(1), C(1)
                 DO 20 I=1,3
                 SUM=0.
5                DO 10 J=1,3
              10 SUM=SUM+A(I,J)*B(J)
              20 C(I)=SUM
                 RETURN
                 END
```

```
RCALC    45
RCALC    46
RCALC    47
RCALC    48
RCALC    49
RCALC    50
RCALC    51
RCALC    52
RCALC    53
```



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```
PROGRAM OUTPLT     73/74   OPT=1 TRACE                    GUF 4.5+414        10/25/76  12.23.40        PAGE     1

      1              OVERLAY ( FILE0, 3, 10, C030443 )                                          OUTPLT      2
                     PROGRAM OUTPLT                                                             OUTPLT      3
                     COMMON NODES,NELEM,E(720),PR(720),TH(720),X(400,3),NB(720,3),NODIS         OUTPLT      4
                    1(400,6),BC(400,6),COMT(13),RPMX,RPMY,RPMZ,GAMMA                            OUTPLT      5
      5              COMMON /KGCALC/ KKPASS,SIGX(720),SIGY(720),TAUXY(720)                      OUTPLT      6
                     COMMON / DISPL / DISP1(400,3),NG                                           OUTPLT      7
                     COMMON / ARRAYS / Y(400),Z(400),P(6),Q(6),YMIN,ZMIN,DELY                   OUTPLT      8
                     COMMON/THERML/ TMPT(720),TMPB(720),ALPHAT(720)                             OUTPLT      9
                     COMMON / QPLOT / NRADST                                                    OUTPLT     10
     10              COMMON / OUTSID / YOUT(102), ZOUT(102), NOUT                               OUTPLT     11
                     DATA           L1,L3 / 1HX,1HZ /                                           OUTPLT     12
                C                                                                               OUTPLT     13
                     CALL PLOTS (0.0,1)                                                         OUTPLT     14
                  50 IF (NG .EQ. 1 .OR. NG .EQ. 8) GO TO 70                                     OUTPLT     15
     15              CALL PRADAX (L1,X(1,1),X(1,3))                                             OUTPLT     16
                     GO TO 90                                                                   OUTPLT     17
                  70 CALL PRADAX (L3,X(1,3),X(1,1))                                             OUTPLT     18
                  90 CALL SYMBB  (-6.0,11.,.21,COMT,0.,78)                                      OUTPLT     19
                     CALL PLOT (9.,-13.,-3)                                                     OUTPLT     20
     20              CALL PLOT (0.,0.,999)                                                      OUTPLT     21
                     WRITE (6,1000)                                                             OUTPLT     22
                1000 FORMAT (/// 1H0,10(1H*) , 9HPLOT MADE       )                             OUTPLT     23
                     END                                                                        OUTPLT     24
```



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```
      SUBROUTINE PRADAX(L1,AXXS,XORZ)                                    PRADAX     2
      DIMENSION AXXS(1),XORZ(1)                                          PRADAX     3
      COMMON NODES,NELEM,E(720),PR(720),TH(720),X(400,3),NB(720,3),NODIS PRADAX     4
     1(400,6),BC(400,6),COMT(13),RPMX,RPMY,RPMZ,GAMMA                    PRADAX     5
      COMMON /KGCALC/ KKPASS,SIGX(720),SIGY(720),TAUXY(720)              PRADAX     6
      COMMON / ARRAYS / Y(400),Z(400),P(6),Q(6),YMIN,ZMIN,DELY           PRADAX     7
      COMMON/THERML/ TMPT(720),TMPB(720),ALPHAT(720)                     PRADAX     8
      COMMON / QPLOT / NRADST                                            PRADAX     9
      COMMON / OUTSID / YOUT(102), ZOUT(102), NOUT                       PRADAX    10
      DIMENSION MESS1(3),MESS2(3),MESS3(3)                               PRADAX    11
      DATA MESS1 / 10HPRINCIPAL  ,10HSTRESSES    ,5H(KSI) /              PRADAX    12
      DATA MESS2 / 10HEQUIVALENT ,10H STRESS     ,5H(KSI) /              PRADAX    13
      DATA MESS3/ 10HRADIAL    , 10HSTRESS     ,5H(KSI)    /             PRADAX    14
      DATA TOP,BOTTOM / 5H(TOP) , 8H(BOTTOM) /                           PRADAX    15
C                                                                        PRADAX    16
C     CALC. Y,Z ARRAYS, SCALING                                          PRADAX    17
      DO 5 I=1,NODES                                                     PRADAX    18
C     CALCULATE RADIUS VALUES                                            PRADAX    19
      Z(I)=SQRT(XORZ(I)**2+X(I,2)**2)                                    PRADAX    20
    5 Y(I)=AXXS(I)                                                       PRADAX    21
      ZMAX=-1.E30                                                        PRADAX    22
      YMAX=ZMAX                                                          PRADAX    23
      ZMIN=-YMAX                                                         PRADAX    24
      YMIN=ZMIN                                                          PRADAX    25
      DO 10 I=1,NODES                                                    PRADAX    26
      IF (Y(I).GT.YMAX)YMAX=Y(I)                                         PRADAX    27
      IF (Z(I).GT.ZMAX)ZMAX=Z(I)                                         PRADAX    28
      IF (Y(I).LT.YMIN)YMIN=Y(I)                                         PRADAX    29
      IF (Z(I).LT.ZMIN)ZMIN=Z(I)                                         PRADAX    30
   10 CONTINUE                                                           PRADAX    31
      DELY=(YMAX-YMIN)/ 7.75                                             PRADAX    32
      DELZ=(ZMAX-ZMIN)/10.                                               PRADAX    33
C     BOTH SCALES MUST BE THE SAME                                       PRADAX    34
      IF (DELZ.GT.DELY)DELY=DELZ                                         PRADAX    35
      IF (NRADST .EQ. 0) GO TO 100                                       PRADAX    36
      DO 20 I=1,NRADST                                                   PRADAX    37
      YOUT(I)= Y(I)                                                      PRADAX    38
   20 ZOUT(I)= Z(I)                                                      PRADAX    39
      NAXLST= NODES / NRADST                                             PRADAX    40
      J=NRADST + 1                                                       PRADAX    41
      DO 30 I=2,NAXLST                                                   PRADAX    42
      K= I * NRADST                                                      PRADAX    43
      YOUT(J)= Y(K)                                                      PRADAX    44
      ZOUT(J)= Z(K)                                                      PRADAX    45
   30 J= J + 1                                                           PRADAX    46
      L=NRADST * NAXLST + 1                                              PRADAX    47
      DO 40 I=2,NRADST                                                   PRADAX    48
      K= L - 1                                                           PRADAX    49
      YOUT(J)= Y(K)                                                      PRADAX    50
      ZOUT(J)= Z(K)                                                      PRADAX    51
   40 J= J + 1                                                           PRADAX    52
      DO 50 I=2,NAXLST                                                   PRADAX    53
      L= NAXLST - I                                                      PRADAX    54
      K= NRADST * L + 1                                                  PRADAX    55
      YOUT(J)= Y(K)                                                      PRADAX    56
      ZOUT(J)=Z(K)                                                       PRADAX    57
   50 J= J + 1                                                           PRADAX    58
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      NOUT= J - 1                                                    PRADAX     59
      IF (NOUT .GT. 100) CALL EXIT                                   PRADAX     60
60    YOUT(J)=YMIN                                                   PRADAX     61
      ZOUT(J)= ZMIN                                                  PRADAX     62
      J= J + 1                                                       PRADAX     63
      YOUT(J)= DELY                                                  PRADAX     64
      ZOUT(J)= DELY                                                  PRADAX     65
65    60 CONTINUE                                                    PRADAX     66
      CALL PLOT (1.,1.,-3)                                           PRADAX     67
      CALL SYMBOL (.5,-.53,.14,MESS1,0.,28)                          PRADAX     68
      CALL SYMBOL (4.0,-.53,.14,TOP,0.,5)                            PRADAX     69
      CALL PELEM(SIGX,SIGY,2,L1)                                     PRADAX     70
70    CALL PLOT (0.,12.,-3)                                          PRADAX     71
      CALL SYMBOL (.5,-.53,.14,MESS1,0.,28)                          PRADAX     72
      CALL SYMBOL (4.0,-.53,.14,BOTTOM,0.,8)                         PRADAX     73
      CALL PELEM (E,PR,2,L1)                                         PRADAX     74
      CALL PLOT (10.,-12.,-3)                                        PRADAX     75
75    CALL SYMBOL (.5,-.53,.14,MESS2,0.,28)                          PRADAX     76
      CALL SYMBOL (4.0,-.53,.14,TOP,0.,5)                            PRADAX     77
      CALL PELEM (TAUXY,TAUXY,1,L1)                                  PRADAX     78
      CALL PLOT (0.,12.,-3)                                          PRADAX     79
      CALL SYMBOL (.5,-.53,.14,MESS2,0.,28)                          PRADAX     80
80    CALL SYMBOL (4.0,-.53,.14,BOTTOM,0.,8)                         PRADAX     81
      CALL PELEM (TM,TM,1,L1)                                        PRADAX     82
      CALL PLOT (10.,-12.,-3)                                        PRADAX     83
      CALL SYMBOL (.5,-.53,.14,MESS3,0.,28)                          PRADAX     84
      CALL SYMBOL (4.0,-.53,.14,TOP,0.,5)                            PRADAX     85
85    CALL PELEM (TMPT,TMPT,1,L1)                                    PRADAX     86
      CALL PLOT (0.,12.,-3)                                          PRADAX     87
      CALL SYMBOL (.5,-.53,.14,MESS3,0.,28)                          PRADAX     88
      CALL SYMBOL (4.0,-.53,.14,BOTTOM,0.,8)                         PRADAX     89
      CALL PELEM (TMPB,TMPB,1,L1)                                    PRADAX     90
90    RETURN                                                         PRADAX     91
    100 NOUT=0                                                       PRADAX     92
      GO TO 60                                                       PRADAX     93
      END                                                            PRADAX     94
```



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      SUBROUTINE PELEM (F1,F2,NF,L1)                                    PRADAX     95
      DIMENSION F1(1),F2(1)                                             PRADAX     96
      COMMON NODES,NELEM,E(720),PR(720),TH(720),X(400,3),NB(720,3),NODIS PRADAX     97
     1(400,6),HC(400,6),COMT(13),RPMX,RPMY,RPMZ,GAMMA                   PRADAX     98
      COMMON / ARRAYS / Y(400),Z(400),P(6),Q(6),YMIN,ZMIN,DELY          PRADAX     99
      COMMON / OUTSID / YOUT(102), ZOUT(102), NOUT                      PRADAX    100
      DO 30 I=1,NELEM                                                   PRADAX    101
      DO 20 J=1,3                                                       PRADAX    102
      N=NB(I,J)                                                         PRADAX    103
      P(J)=Y(N)                                                         PRADAX    104
   20 Q(J)=Z(N)                                                         PRADAX    105
C     CALCULATE CENTER OF ELEMENT IN INCHES ABSOLUTE. ALLOW SPACE FOR NU PRADAX    106
      YC= ((P(1) + P(2) + P(3))/3. -YMIN) / DELY -.1                    PRADAX    107
      ZC=((Q(1)+Q(2)+Q(3))/3.-ZMIN)/DELY-.05                            PRADAX    108
      CALL NUMBER (YC,ZC,.10,F1(I),0.,-1)                               PRADAX    109
      IF (NF .EQ. 1) GO TO 30                                           PRADAX    110
      ZC= ZC - .1                                                       PRADAX    111
      CALL NUMBER (YC,ZC,.07,F2(I),0.,-1)                               PRADAX    112
   30 CONTINUE                                                          PRADAX    113
      CALL AXIS (0.,-.05,L1,-1,7.,0.,YMIN,DELY)                         PRADAX    114
      CALL AXIS (-.05,0.,6HRADIUS,6,10.  ,90.,ZMIN,DELY)                PRADAX    115
C     OUTLINE BLADE                                                     PRADAX    116
      IF (NOUT .EQ. 0) GO TO 35                                         PRADAX    117
      CALL LINE (YOUT,ZOUT,NOUT,1,1,2)                                  PRADAX    118
C     MARK ALL NODES                                                    PRADAX    119
   35 CONTINUE                                                          PRADAX    120
      DO 40 I=1,NODES                                                   PRADAX    121
      YC= (Y(I) - YMIN) / DELY                                          PRADAX    122
      ZC= (Z(I) - ZMIN) / DELY                                          PRADAX    123
   40 CALL SYMBOL (YC  ,ZC  ,.07,2,0.,-1)                               PRADAX    124
      RETURN                                                            PRADAX    125
      END                                                               PRADAX    126
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      OVERLAY ( FILE0, 3, 6 )                                                  STIFF      2
      PROGRAM STIFF                                                            STIFF      3
      COMMON NODES,NELEM,E(720),PR(720),TH(720),X(400,3),NB(720,3),NODIS       STIFF      4
     1(400,6),BC(400,6),COMT(13),RPMX,RPMY,RPMZ,GAMMA,SPACE(18624)             STIFF      5
      COMMON / SKEW / NSKEW, ISKEW(10), SINT, COST                             STIFF      6
      COMMON / DDISP / NDDISP, I1DDSP(10), I2DDSP(10)                          STIFF      7
      COMMON/THERML/ TMPT(720),TMPB(720),ALPHAT(720)                           STIFF      8
      COMMON /SPRGS/ NNSTIF,NSTIFF(12),XSTIFF(12),YSTIFF(12),ZSTIFF(12)        STIFF      9
     1 , XXSTIF(12), YYSTIF(12), ZZSTIF(12)                                    STIFF     10
      COMMON / DISPL / DISP(400,3),NG                                          STIFF     11
      COMMON / WPLOT / NRADST                                                  STIFF     12
      COMMON / RELAXF / RELAX                                                  STIFF     13
      COMMON /KGCALC/ KKPASS,SIGX(720),SIGY(720),TAUXY(720)                    STIFF     14
      COMMON/LOGIC/NROWS,NCOLM,NG,NUMBLK,NROW2                                 STIFF     15
      COMMON/SPECL/ KSPEC(400)                                                 STIFF     16
      COMMON / GEOMSF / SFGEOM                                                 STIFF     17
      COMMON / COUNT / KOUNTER, MFLAGF, OLDTFT, TOLERC                         STIFF     18
      NRADST=0                                                                 STIFF     19
      NNODES=400                                                               STIFF     20
      NBEAMS=720                                                               STIFF     21
C                                                                              STIFF     22
      WRITE (6,280) COMT                                                       STIFF     23
C     READ MODULUS OF ELASTICITY                                               STIFF     24
C                                                                              STIFF     25
      IN= 63                                                                   STIFF     26
      RPMY= 0.                                                                 STIFF     27
      READ (IN,150) EE, P1, PPR, GAMMA, RPMX, ALPFOL, RPMZ, ALPHA,             STIFF     28
     1 RELAX, P2                                                               STIFF     29
      NDDISP= P2                                                               STIFF     30
C     NOTE-- ALPFOL IS ANGLE FOR SKEW IN X-Y PLANE                             STIFF     31
C       ALPFOL REPRESENTS AN X-AXIS ROTATION OF (-ALPFOL) DEGREES              STIFF     32
C                                                                              STIFF     33
C     P2 IS THE NO. OF DDISP PAIRS                                             STIFF     34
C                                                                              STIFF     35
      COST= 1.                                                                 STIFF     36
      SINT= 0.                                                                 STIFF     37
      P3= ALPFOL / 57.29578                                                    STIFF     38
      IF (ALPFOL .EQ. 0.) GO TO 2                                              STIFF     39
      COST=COS(P3)                                                             STIFF     40
      SINT= - SIN(P3)                                                          STIFF     41
    2 CONTINUE                                                                 STIFF     42
      IF (RELAX .EQ. 0. ) RELAX= 1.                                            STIFF     43
      ALPHA=ALPHA*1.E-06                                                       STIFF     44
      IF (GAMMA.LE.0.) GAMMA=.16                                               STIFF     45
      EE=EE*1.E06                                                              STIFF     46
      NNSTIF=P1                                                                STIFF     47
      IF (PPR.LE.0.) PPR=.3                                                    STIFF     48
      IF (KOUNTER .EQ. 1) WRITE (6,180) EE,PPR,GAMMA,RPMX,RPMZ,                STIFF     49
     1 ALPHA, RELAX, NDDISP, ALPFOL                                            STIFF     50
      IF (NDDISP .LE. 10) GO TO 3                                              STIFF     51
      PRINT 181                                                                STIFF     52
      STOP                                                                     STIFF     53
    3 CONTINUE                                                                 STIFF     54
C     READ NODAL DATA                                                          STIFF     55
C                                                                              STIFF     56
      IF ( KOUNTER .EQ. 1) WRITE (6,220)                                       STIFF     57
      DO 10 I=1,NNODES                                                         STIFF     58
```

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0 0 5 9 2 3

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                NODES=1                                                          STIFF     59
                READ (IN,250) P1, P2, P3, P4, P5, P6, (X(I,J), J=1,3), LC        PELEM      2
60             1 , K                                                             PELEM      3
                IF ( K.EQ. 0) GO TO 5                                            PELEM      4
                IF (NSKEW .NE. 10) GO TO 4                                       PELEM      5
                PRINT 182                                                        PELEM      6
              182 FORMAT (22H0MAX. OF 10 SKEW NODES     )                        PELEM      7
65              STOP                                                             PELEM      8
              4 NSKEW= NSKEW + 1                                                 PELEM      9
                ISKEW(NSKEW)= I                                                  PELEM     10
              5 CONTINUE                                                         PELEM     11
                NODIS(I,1)=P1                                                    PELEM     12
70              NODIS(I,2)=P2                                                    PELEM     13
                NODIS(I,3)=P3                                                    PELEM     14
                NODIS(I,4)=P4                                                    PELEM     15
                NODIS(I,5)=P5                                                    PELEM     16
                NODIS(I,6)=P6                                                    PELEM     17
75              IF ( KOUNTER .NE. 1) GO TO 9                                     PELEM     18
                WRITE (6,210) I,(NODIS(I,J),J=1,6),(X(I,J),J=1,3)                PELEM     19
               1, K                                                              PELEM     20
              9 CONTINUE                                                         PELEM     21
                IF (LC) 10,10,20                                                 PELEM     22
80            10 CONTINUE                                                        PELEM     23
C               ERROR--TOO MUCH NODAL DATA                                       PELEM     24
                GO TO 140                                                        PELEM     25
              20 PRINT 3456, NSKEW                                               PELEM     26
            3456 FORMAT (1H0, I3, 31H NODES ARE SKEWED WRT X-Y PLANE     )       PELEM     27
85          C                                                                    PELEM     28
            C     READ STRUCTURAL DATA                                           PELEM     29
            C                                                                    PELEM     30
                IF (KOUNTER .EQ.1) WRITE(6,230) COMT                             PELEM     31
                DO 40 I=1,NBEAMS                                                 PELEM     32
90              NELEM=I                                                          PELEM     33
                READ (IN,250) P1, P2, P3, P4, P5, P6, TMPT(I), TMPB(I),ALPHAT(I),PELEM     34
               1 LC                                                              PELEM     35
                ALPHAT(I)=ALPHAT(I)*1.E-06                                       PELEM     36
                IF (ALPHAT(I).LE.0.) ALPHAT(I)=ALPHA                             PELEM     37
95              IF (TMPT(I).EQ.0.) TMPT(I)=70.                                   PELEM     38
                IF (TMPB(I).EQ.0.) TMPB(I)=TMPT(I)                               PELEM     39
                NB(I,1)=P1                                                       PELEM     40
                NB(I,2)=P2                                                       PELEM     41
                NB(I,3)=P3                                                       PELEM     42
100             TH(I)=P4                                                         PELEM     43
                IF (P4 .EQ. 0.) TH(I)= TH(I-1)                                   PELEM     44
                P5=P5*1.E06                                                      PELEM     45
                IF (P5.LE.0.) P5=EE                                              PELEM     46
                IF (P6.LE.0.) P6=PPR                                             PELEM     47
105             E(I)=P5                                                          PELEM     48
                PR(I)=P6                                                         PELEM     49
                IF (KOUNTER .NE. 1) GO TO 29                                     PELEM     50
                WRITE (6,240) I,(NB(I,J),J=1,3),TH(I),E(I),PR(I),TMPT(I),TMPB(I),APELEM     51
               1LPHAT(I)                                                         PELEM     52
110           29 CONTINUE                                                        PELEM     53
                DO 30 J=1,3                                                      PELEM     54
                IF (NB(I,J).LT.1.OR.NB(I,J).GT.NODES) GO TO 140                  PELEM     55
              30 CONTINUE                                                        PELEM     56
                IF (LC) 40,40,50                                                 PELEM     57
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      40 CONTINUE                                                        PELEM      58
         GO TO 140                                                       PELEM      59
      50 CONTINUE                                                        PELEM      60
         IF (RPMX .NE. 0.) NG=2                                          PELEM      61
         IF (RPMZ .NE. 0.) NG=1                                          PELEM      62
C                                                                        PELEM      63
         IF (SFGEOM .NE. 0.) WRITE (6,8701) SFGEOM                       PELEM      64
 8701 FORMAT (1H0, 40(2H* ) / 82H THE ABOVE NODAL COORD. AND ELEMENT THI PELEM      65
     1CK. WERE PRINTED BEFORE BEING MULTIPLIED BY       ,F10.6  /       PELEM      66
     2 1X, 40(2H* )    )                                              PELEM      67
         IF (NODES.GT.400) GO TO 140                                     PELEM      68
         IF (NELEM.GT.720) GO TO 140                                     PELEM      69
         IF (NNSTIF.EQ.0) GO TO 80                                       PELEM      70
         IF (NNSTIF.GT.12) GO TO 140                                     PELEM      71
         IF (KOUNTER .EQ. 1) WRITE(6,190) NNSTIF                         PELEM      72
         DO 70 I=1,NNSTIF                                                PELEM      73
         READ (IN,150) P1, XSTIFF(I),YSTIFF(I),ZSTIFF(I)                 PELEM      74
        1 , XXSTIF( I), YYSTIF( I), ZZSTIF( I)                           PELEM      75
         NSTIFF(I)=P1                                                    PELEM      76
         IF (KOUNTER .NE. 1) GO TO 70                                    PELEM      77
         WRITE (6,200) P1,XSTIFF(I),YSTIFF(I),ZSTIFF(I)                  PELEM      78
        1 , XXSTIF( I), YYSTIF( I), ZZSTIF( I)                           PELEM      79
      70 CONTINUE                                                        PELEM      80
      80 IF (NDDISP .LE. 0) GO TO 84                                     PELEM      81
         IF (KOUNTER .EQ. 1) PRINT 4567, NDDISP                          PELEM      82
 4567 FORMAT (1H0, I3, 23H PAIR OF DIF DISPL NODE  / 1H0,5X,2HI, 5X,1HJ) PELEM      83
         DO 82 I=1,NDDISP                                                PELEM      84
         READ (IN,150) P1,P2                                             PELEM      85
         N1= P1                                                          PELEM      86
         N2= P2                                                          PELEM      87
         N3= MIN0 (N1, N2)                                               PELEM      88
         N4= MAX0 (N1, N2)                                               PELEM      89
         N1= N4 - N3                                                     PELEM      90
         I1DDSP(I)= N3                                                   PELEM      91
         I2DDSP(I)= N4                                                   PELEM      92
         IF (KOUNTER .EQ. 1) PRINT 5678, N3, N4                          PELEM      93
 5678 FORMAT (1X, 2I6)                                                   PELEM      94
         IF (N1 .NE. 0 .AND. N3 .LE. NODES .AND. N4 .LE. NODES .AND. N3  PELEM      95
        1  .GT. 0 .AND. N4 .GT. 0 ) GO TO 81                            PELEM      96
      83 PRINT 6789                                                      PELEM      97
 6789 FORMAT (10H0BAD DDISP    )                                         PELEM      98
         STOP                                                            PELEM      99
      81 DO 82 J=1,6                                                     PELEM     100
         IF (NODIS(N3,J) .NE. NODIS(N4,J) ) GO TO 83                     PELEM     101
      82 CONTINUE                                                        PELEM     102
      84 CONTINUE                                                        PELEM     103
C     CONVERT RPM TO RAD/SEC                                             PELEM     104
         RPMX=RPMX*.10471976                                             PELEM     105
         RPMY=RPMY*.10471976                                             PELEM     106
         RPMZ=RPMZ*.10471976                                             PELEM     107
C     CONVERT DENSITY TO LBF*SEC**2/IN**4                                PELEM     108
         GAMMA=GAMMA/386.04                                              PELEM     109
C     READ APPLIED FORCES/SPECIFIED DISPLACEMENTS                        PELEM     110
         REWIND 64                                                       PELEM     111
         REWIND 65                                                       PELEM     112
 8840 READ (IN,150) P1                                                   PELEM     113
         IF (EOF(IN)) 110,85                                             PELEM     114
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     85 CONTINUE                                                          PELEM  115
        NBC=P1                                                            PELEM  116
        IF (NBC.EQ.0) GO TO 110                                           PELEM  117
175     WRITE (6,160) NBC                                                 PELEM  118
        DO 100 I=1,NBC                                                    PELEM  119
        READ (IN,150) P1, (SPACE(J), J=1,6)                               PELEM  120
        K=P1                                                              PELEM  121
        IF (NDDISP .EQ. 0) GO TO 87                                       PELEM  122
180     DO 86 J=1,NDDISP                                                  PELEM  123
        IF (K .NE. I1DDSP(J) ) GO TO 86                                   PELEM  124
        K= I2DDSP(J)                                                      PELEM  125
        GO TO 87                                                          PELEM  126
     86 CONTINUE                                                          PELEM  127
185  87 CONTINUE                                                          PELEM  128
        DO 90 J=1,6                                                       PELEM  129
     90 BC(K,J)= SPACE(J) + BC(K,J)                                       PELEM  130
    100 WRITE (6,170) K,(SPACE(J),J=1,6)                                  PELEM  131
C       DETERMINE NW                                                      PELEM  132
190 110 IF (IN .EQ. 64) GO TO 8110                                        PELEM  133
        IN= 64                                                            PELEM  134
        GO TO 8840                                                        PELEM  135
 8110   NW= 0                                                             PELEM  136
        IN= 63                                                            PELEM  137
195     DO 120 I=1,NELEM                                                  PELEM  138
        IF (SFGEOM .NE. 0.) TH(I)= TH(I) * SFGEOM                         PELEM  139
        N1=NB(I,1)                                                        PELEM  140
        N2=NB(I,2)                                                        PELEM  141
        N3=NB(I,3)                                                        PELEM  142
200     IF (NDDISP .EQ. 0) GO TO 120                                      PELEM  143
        N4= N1                                                            PELEM  144
        N5= N2                                                            PELEM  145
        N6= N3                                                            PELEM  146
        DO 114 J=1,NDDISP                                                 PELEM  147
205     IF (N1 .EQ. I1DDSP(J) ) N4= I2DDSP(J)                             PELEM  148
        IF (N2 .EQ. I1DDSP(J) ) N5= I2DDSP(J)                             PELEM  149
        IF (N3 .EQ. I1DDSP(J) ) N6= I2DDSP(J)                             PELEM  150
        IF (N1 .EQ. I2DDSP(J) ) N4= I1DDSP(J)                             PELEM  151
        IF (N2 .EQ. I2DDSP(J) ) N5= I1DDSP(J)                             PELEM  152
210     IF (N3 .EQ. I2DDSP(J) ) N6= I1DDSP(J)                             PELEM  153
    114 CONTINUE                                                          PELEM  154
        NW= MAX0 ( NW, IABS(N1-N6), IABS(N2-N6) )                         PELEM  155
        NW= MAX0 ( NW, IABS(N2-N4), IABS(N3-N4) )                         PELEM  156
        NW= MAX0 ( NW, IABS(N3-N5), IABS(N1-N5) )                         PELEM  157
215 120 NW=AMAX0(NW,IABS(N1-N2),IABS(N1-N3),IABS(N2-N3))                  PELEM  158
        PRINT 260, NW                                                     PELEM  159
C       NEED SPACE OF  (NCOLS+1)*2*NCOLS, WHERE NCOLS=6*(NW+1)            PELEM  160
        IF (NW.GT.15) GO TO 140                                           PELEM  161
        NCOLM= 6*(NW+1)                                                   PELEM  162
220     NROW2= 96                                                         PELEM  163
        NROWS=192                                                         PELEM  164
        NQ=16                                                             PELEM  165
C       CHECK FOR ADEQUATE STORAGE FOR BANSOL                             PELEM  166
        I= NODES / NQ + 1                                                 PELEM  167
225     IF (I .GT. NCOLM) NCOLM= I                                        PELEM  168
        IF (SFGEOM .EQ. 0.) GO TO 703                                     PELEM  169
        DO 702 I=1,NODES                                                  PELEM  170
        X(I,1)= X(I,1) * SFGEOM                                           PELEM  171
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                X(I,2)= X(I,2) * SFGEOM                                          PELEM    172
230             X(I,3)= X(I,3) * SFGEOM                                          PELEM    173
              702 CONTINUE                                                       PELEM    174
              703 CONTINUE                                                       PELEM    175
            C     CHECK FOR SPECIAL NODES TO BE HANDLED IN LOCAL COORDINATES     PELEM    176
                  DO 600 I=1,NODES                                               PELEM    177
235               KSPEC(I)=0                                                     PELEM    178
            C*** SPECIAL NODES NOT REQUIRED DUE TO BARS ADDED TO PLATE ELEMENTS  PELEM    179
              600 CONTINUE                                                       PELEM    180
              160 FORMAT (24H0BOUNDARY CONDITIONS FORI5,6H NODES/76H0NODE    FX OR U PELEM    181
                 1X    FY OR UY    FZ OR UZ    MX OR RX    MY OR RY    MZ OR RZ) PELEM    182
240           170 FORMAT (1X,I5,6E12.4)                                          PELEM    183
              190 FORMAT (/26H0SPRING RATES (LBF/IN) FOR,I3,6H NODES/5H0NODE,6X,2HKX PELEM    184
                 1,8X,2HKY,8X,2HKZ)                                              PELEM    185
              200 FORMAT ( 1X, F4.0, 1P6E10.3 )                                  PELEM    186
              260 FORMAT (4H0NW=I3  /)                                           PELEM    187
245               GO TO 145                                                      PELEM    188
              140 CALL DIMEPR (6HSTIFFN    )                                     PELEM    189
              145 CONTINUE                                                       PELEM    190
              150 FORMAT (10F7.0)                                                PELEM    191
              180 FORMAT (22H0MODULUS OF ELASTICITYE12.4,5X,14HPOISSONS RATIOF6.3,5X PELEM    192
250              1,7HDENSITY,F6.3/6H RPM-- 5X, F8.0,4H (X),5X,F8.0, 4H (Z) /     PELEM    193
                 2 7H ALPHA= E12.4, 5X, 6HRELAX= F5.3, 5X, 7HNODISP= I3,5X,      PELEM    194
                 3 8HALPFOL=  F7.2 )                                             PELEM    195
              181 FORMAT (23H0MAX. OF 10 DOISP PAIRS     )                       PELEM    196
              210 FORMAT (7I5, 3F10.4, I6 )                                      PELEM    197
255           220 FORMAT (1H0,14X,14HBOUNDARY CODES,14X,16HCOORDINATES (IN)/3H NODE PELEM    198
                 1  UX   UY   UZ   RX   RY   RZ ,5X,1HX,9X,1HY,9X,1HZ,8X,4HSKEW )  PELEM    199
              230 FORMAT (1H1,13A6/1H0,16X,5HNODES,7X,6HTHICK.,5X,1HE,17X,14HTEMPERA PELEM    200
                 1TURE, F,5X,5HALPHA/5H ELEM,9X,1HI,4X,1HJ,4X,1HK,5X,4H(IN),5X,5H(PS PELEM    201
                 2),7X,2HMU,9X,3HTOP,4X,6HBOTTOM,2X,8H1N/IN/DF)                  PELEM    202
260           240 FORMAT (I5,5X,3I5,F10.4,E10.3,F10.3,2F10.0,E10.3)              PELEM    203
              250 FORMAT (7X, 9F7.0, 1X, I1, 7X, I1 )                            PELEM    204
              280 FORMAT (1H0,13A6)                                              PELEM    205
                  END                                                            PELEM    206
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      OVERLAY ( FILE0, 2, 0 )                                                  J508P2      2
      PROGRAM J508P2                                                           J508P2      3
C      **************        PROGRAM  508P2  11-27-68        ************      J508P2      4
C     HYDRODYNAMIC THRUST BEARING PROGRAM 508-1                                J508P2      5
      COMMON /ZCOM00/P,IP,H,DELTA,DELTB,QLT,QMT,QRT,RE,RKCF,DIFV,PAHTH,R       J508P2      6
     +HS,FT,FR,PAPTH,PAPR,RKP,TKP,UBAR,WBAR,CODE                               J508P2      7
      COMMON/ZCOM01/ OP,OOP                                                    J508P2      8
      COMMON / COUNT / KOUNTER, MFLAGF, OLDTFT, TOLERC                         J508P2      9
      DIMENSION P(21,21),IP(21,21),H(21,21),DELTA(21,21),DELTB(21,21),QL       J508P2     10
     1T(21,21),QMT(21,21),QRT(21,21),RE(21,21),RKP(21,21),TKP(21,21),DIF      J508P2     11
     2V(21,21),PAHTH(21,21),PHS(21,21),FT(21,21),FR(21,21),THETA(21),R(2      J508P2     12
     31),DELRA(21),DELRB(21),QLR(21),QMR(21),QRR(21),PAPTH(21,21),PAPR(2      J508P2     13
     41,21),PTR(21,21),PDR(21,21),UBAR(21,21),WBAR(21,21),CODE(21,21),RL      J508P2     14
     5T(21),RMT(21),RRT(21),PLT(21),PMT(21),PRT(21),OP(21,21),OOP(21,21)      J508P2     15
     6,RKCF(21,21),PT(441),PL(441),AREA(441),UZ(441),FO(441)                  J508P2     16
      EQUIVALENCE (OP,PTR),(OOP,PDR)                                           J508P2     17
C                                                                              J508P2     18
      DIMENSION NTRANS(21,21)                                                  J508P2     19
C                                                                              J508P2     20
      DATA IX/62/,IY/61/,IZ/61/                                                J508P2     21
      ROUND(A)=FLOAT(IFIX(ABS(A)+.5))                                          J508P2     22
      FMAT(A)=SIGN(ROUND(A),A)                                                 J508P2     23
      CALL MEMSET(P(1,1),CODE(21,21),0)                                        J508P2     24
      CALL MEMSET(OP(1,1),OOP(21,21),0)                                        J508P2     25
      ITERI=0                                                                  J508P2     26
      CORRE=100.                                                               J508P2     27
      AITO=0.                                                                  J508P2     28
   10 WRITE(IY,1980)                                                           J508P2     29
C     READ IDENTIFICATION CARD 1                                               J508P2     30
      REWIND IX                                                                J508P2     31
      READ(IX,1990)                                                            J508P2     32
      IF(EOF(IX))999,1                                                         J508P2     33
    1 CONTINUE                                                                 J508P2     34
      WRITE(IZ,1990)                                                           J508P2     35
      READ(IX,2000)RR1,RRM,RHO,U9,VAPP,AMBP,CONK,RECR,ERRDP,PANG,RELAX,        J508P2     36
     1EXT                                                                      J508P2     37
      IF (EXT)30,20,30                                                         J508P2     38
   20 IEXT=3                                                                   J508P2     39
      EXT=3.                                                                   J508P2     40
      GO TO 40                                                                 J508P2     41
   30 IEXT=EXT                                                                 J508P2     42
   40 WRITE(IY,2010)                                                           J508P2     43
      IF (KOUNTER .NE. 1 ) GO TO 6000                                          J508P2     44
      WRITE(IY,2020)                                                           J508P2     45
      WRITE(IZ,2030)RR1,RRM,RHO,U9,VAPP,AMBP                                   J508P2     46
      WRITE(IY,2040)                                                           J508P2     47
      WRITE(IZ,2050)CONK,RECR,ERRDP,PANG,RELAX,EXT                             J508P2     48
 6000 CONTINUE                                                                 J508P2     49
      READ (IX,7766)S,RP,TP,PHIR,PHIT,HP, NBARQQ                               J508P2     50
 7766 FORMAT (6E12.3, 6X, I2 )                                                 J508P2     51
      WRITE (IY,7767) NBARQQ                                                   J508P2     52
 7767 FORMAT ( 6H0NBAR=   I4 )                                                 J508P2     53
      IF (KOUNTER .NE. 1 ) GO TO 6010                                          J508P2     54
      WRITE(IY,2060)                                                           J508P2     55
      WRITE(IZ,2030)S,RP,TP,PHIR,PHIT,HP                                       J508P2     56
 6010 CONTINUE                                                                 J508P2     57
      READ(IX,2070)M,N,LP,MPRI,IRO,IHP,IRT,IRR,IRN,IRC,IRS,IRH,INC,INERT       J508P2     58
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     1,LI,ICEC,ICAP,ICHAM                                                    J508P2    59
      IF (KOUNTER .NE. 1 ) GO TO 6020                                        J508P2    60
60    WRITE(IY,2060)                                                         J508P2    61
      WRITE(IZ,2090)M,N,LP,MPRT,IRO,IRP,IRT,IRR,IRN,IRC,IRS,IRH,INC,INER     J508P2    62
     1T,LI,ICEC,ICAP,ICHAM                                                   J508P2    63
 6020 CONTINUE                                                              J508P2    64
      NN=N-1                                                                J508P2    65
65    IF (ICEC-1)60,50,60                                                    J508P2    66
   50 IS=1                                                                  J508P2    67
      IE=N                                                                  J508P2    68
      GO TO 70                                                              J508P2    69
   60 IS=2                                                                  J508P2    70
70    IE=NN                                                                 J508P2    71
   70 SERDP=0.                                                              J508P2    72
      SERFR=0.                                                              J508P2    73
      SERFI=0.                                                              J508P2    74
      SUMP2=0.                                                              J508P2    75
75    SUMP1=0.                                                              J508P2    76
      ITERT=0.                                                              J508P2    77
      IIRT=0                                                                J508P2    78
      SUMI=0.                                                               J508P2    79
      ITERI=0.                                                              J508P2    80
80    ERRDI=ERRDP                                                           J508P2    81
      HOD=0.                                                                J508P2    82
      BETAD=0.                                                              J508P2    83
      CAPPS=0.                                                              J508P2    84
      PSID=0.                                                               J508P2    85
85    BETA=0.                                                               J508P2    86
      KERIC=1                                                               J508P2    87
      CONDR=57.2957795                                                      J508P2    88
      PI=3.14159                                                            J508P2    89
C     CONVERT TO CORRECT UNITS                                              J508P2    90
90    MN=M*N                                                                J508P2    91
      DO 71 I=1,MN                                                          J508P2    92
      PL(I)=0.                                                              J508P2    93
   71 AREA(I)=0.                                                            J508P2    94
      S=(S*PI)/30.                                                          J508P2    95
95    RHO=RHO/386.04                                                        J508P2    96
      TP=TP/CONDR                                                           J508P2    97
      PANG=PANG/CONDR                                                       J508P2    98
      M1=M-1                                                                J508P2    99
      M2=M-2                                                                J508P2   100
100   NN=N-1                                                                J508P2   101
C     GENERATE CONSTANT MATRIX VALUES                                       J508P2   102
      IF (1.GT.M)GO TO 5                                                    J508P2   103
      DO 80 I=1,M                                                           J508P2   104
      DO 80 J=1,N                                                           J508P2   105
105   H(I,J)=HP                                                             J508P2   106
   80 IP(I,J)=0                                                             J508P2   107
    5 CONTINUE                                                              J508P2   108
      IF (1.GT.N)GO TO 15                                                   J508P2   109
      DO 90 J=1,N                                                           J508P2   110
110   IP(1,J)=1                                                             J508P2   111
   90 IP(M,J)=1                                                             J508P2   112
   15 CONTINUE                                                              J508P2   113
      IF (ICEC-1)100,120,100                                                J508P2   114
  100 IF (1.GT.M)GO TO 25                                                   J508P2   115
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115                 DO 110 I=1,M                                                  J508P2   116
                    IP(I,1)=1                                                     J508P2   117
                110 IP(I,N)=1                                                     J508P2   118
                 25 CONTINUE                                                      J508P2   119
                C   GENERATE PRESSURES                                            J508P2   120
120              120 IF (1.GT.M)GO TO 35                                          J508P2   121
                    DO 130 I=1,M                                                  J508P2   122
                    DO 130 J=1,N                                                  J508P2   123
                130 P(I,J)=AMBP                                                   J508P2   124
                 35 CONTINUE                                                      J508P2   125
125                 ICKCGT=IRO                                                    J508P2   126
                    IF (ICKCGT.LE.1)GO TO 140                                     J508P2   127
                    IF (ICKCGT.GE.2)GO TO 160                                     J508P2   128
                    GO TO (140,160),ICKCGT                                        J508P2   129
                C   READ ORIFICE DATA                                             J508P2   130
130              140 READ(IX,2100)AD,CD,SHR,PS,RGAS,TGAS                          J508P2   131
                    IF (KOUNTER .EQ. 1 ) WRITE (IZ,2110) AD,CD,SHR,PS,RGAS,TGAS  J508P2   132
                    RGAS=4640.*RGAS                                               J508P2   133
                    AO=PI*((AD/2.)**2)                                            J508P2   134
                C   SET INTERNAL PRESSURES EQUAL TO SUPPLY PRESSURES               J508P2   135
135                 IF (2.GT.M1)GO TO 45                                          J508P2   136
                    DO 150 I=2,M1                                                 J508P2   137
                    DO 150 J=IS,IE                                                J508P2   138
                150 P(I,J)=PS                                                     J508P2   139
                 45 CONTINUE                                                      J508P2   140
140                 CHOKT=(2./(SHR+1.))**(SHR/(SHR-1.))                           J508P2   141
                160 ICKCGT=ICAP                                                   J508P2   142
                    IF (ICKCGT.LE.1)GO TO 170                                     J508P2   143
                    IF (ICKCGT.GE.2)GO TO 180                                     J508P2   144
                    GO TO (170,180),ICKCGT                                        J508P2   145
145             C   READ CAPILLARY DATA                                           J508P2   146
                170 READ(IX,2120)CAPD,CAPL,CAPPS                                  J508P2   147
                    IF (KOUNTER .EQ. 1 ) WRITE (IY,2130) CAPD,CAPL,CAPPS          J508P2   148
                180 ICKCGT=IRP                                                    J508P2   149
                    IF (ICKCGT.LE.1)GO TO 190                                     J508P2   150
150                 IF (ICKCGT.GE.2)GO TO 200                                     J508P2   151
                    GO TO (190,200)ICKCGT                                         J508P2   152
                C   READ PRESSURES                                                J508P2   153
                190 READ(IX,2140)(I,J,P(I,J),IP(I,J),NEXT)                        J508P2   154
                    IMN=M*(J-1)+I                                                 J508P2   155
155                 PL(IMN)=P(I,J)                                                J508P2   156
                    ICKCGT=NEXT                                                   J508P2   157
                    IF (ICKCGT.LE.1)GO TO 190                                     J508P2   158
                    IF (ICKCGT.GE.2)GO TO 200                                     J508P2   159
                    GO TO (190,200),ICKCGT                                        J508P2   160
160             C   READ THETA VALUES                                             J508P2   161
                200 ICKCGT=IRT                                                    J508P2   162
                    IF (ICKCGT.LE.1)GO TO 210                                     J508P2   163
                    IF (ICKCGT.GE.2)GO TO 230                                     J508P2   164
                    GO TO (210,230),ICKCGT                                        J508P2   165
165              210 READ(IX,2160)(THETA(J),J=1,N)                                J508P2   166
                    IF (KOUNTER .NE. 1 ) GO TO 6030                               J508P2   167
                    WRITE(IY,2150)                                                J508P2   168
                    WRITE(IZ,2160)(THETA(J),J=1,N)                                J508P2   169
                    WRITE(IY,2010)                                                J508P2   170
170              6030 CONTINUE                                                    J508P2   171
                    IF (1.GT.N)GO TO 55                                           J508P2   172
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                      DO 220 J=1,N                                          J508P2   173
                  220 THETA(J)=THETA(J)/CONDR                               J508P2   174
                   55 CONTINUE                                              J508P2   175
                      GO TO 280                                             J508P2   176
                C     CALCULATE THETA VALUES FOR EACH COLUMN                J508P2   177
                  230 FN=N                                                  J508P2   178
                      IF (ICEC-1)250,240,250                                J508P2   179
                  240 DELTT=PANG/(FN)                                       J508P2   180
                      GO TO 260                                             J508P2   181
                  250 DELTT=PANG/(FN-1.)                                    J508P2   182
                  260 THETA(1)=0.                                           J508P2   183
                      IF (2.GT.N)GO TO 65                                   J508P2   184
                      DO 270 J=2,N                                          J508P2   185
                      JM=J-1                                                J508P2   186
                  270 THETA(J)=THETA(JM)+DELTT                              J508P2   187
                   65 CONTINUE                                              J508P2   188
                C     READ RADIUS VALUES                                    J508P2   189
                  280 ICKCGT=IRR                                            J508P2   190
                      IF (ICKCGT.LE.1)GO TO 290                             J508P2   191
                      IF (ICKCGT.GE.2)GO TO 300                             J508P2   192
                      GO TO (290,300),ICKCGT                                J508P2   193
                  290 READ(IX,2180)(R(I),I=1,M)                             J508P2   194
                      IF (KOUNTER .NE. 1 ) GO TO 320                        J508P2   195
                      WRITE(IY,2170)                                        J508P2   196
                      WRITE(IY,2180)(R(I),I=1,M)                            J508P2   197
                      WRITE (IY,2010)                                       J508P2   198
                      GO TO 320                                             J508P2   199
                C     GENERATE R VALUES FOR EACH ROW                        J508P2   200
                  300 FN=M                                                  J508P2   201
                      DELTR=(RRM-RR1)/(FN-1)                                J508P2   202
                      R(1)=RR1                                              J508P2   203
                      IF (2.GT.M)GO TO 75                                   J508P2   204
                      DO 310 I=2,M                                          J508P2   205
                      IM=I-1                                                J508P2   206
                  310 R(I)=R(IM)+DELTR                                      J508P2   207
                   75 CONTINUE                                              J508P2   208
                C     READ NUTATION DYNAMICS                                J508P2   209
                  320 ICKCGT=IRN                                            J508P2   210
                      IF (ICKCGT.LE.1)GO TO 330                             J508P2   211
                      IF (ICKCGT.GE.2)GO TO 340                             J508P2   212
                      GO TO (330,340),ICKCGT                                J508P2   213
                  330 READ(IX,2000)BETA,BETAD,PSID,HOD,AITO                 J508P2   214
                      IF (KOUNTER .NE. 1 ) GO TO 6040                       J508P2   215
                      WRITE(IY,2190)                                        J508P2   216
                      WRITE(IY,2200)BETA,BETAD,PSID,HOD,AITO                J508P2   217
                 6040 CONTINUE                                              J508P2   218
                      PSID=PSID*PI/30.                                      J508P2   219
                      AITO=AITO/CONDR                                       J508P2   220
                C     READ CROWN INPUT                                      J508P2   221
                  340 ICKCGT=IRC                                            J508P2   222
                      IF (ICKCGT.LE.1)GO TO 350                             J508P2   223
                      IF (ICKCGT.GE.2)GO TO 410                             J508P2   224
                      GO TO (350,410),ICKCGT                                J508P2   225
                  350 READ(IX,2210)ROC,IROC                                 J508P2   226
                      IF (KOUNTER .NE. 1 ) GO TO 6050                       J508P2   227
                      WRITE(IY,2220)                                        J508P2   228
                      WRITE(IY,2230)ROC,IROC                                J508P2   229
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      6050 CONTINUE                                                          J508P2   230
230        IF (1.GT.M)GO TO 85                                              J508P2   231
           DO 400 I=1,M                                                     J508P2   232
           DO 400 J=1,N                                                     J508P2   233
           IF (IROC-3)370,360,370                                           J508P2   234
       360 H(I,J)=HP+(R(I))**2/(2.*ROC)                                     J508P2   235
235        GO TO 400                                                        J508P2   236
       370 BR2=((R(I)-PP)*COS(THETA(J)-TP)*PHIR)+(R(I)*SIN(THETA(J)-TP)*PHIT) J508P2   237
           ICKCGT=IROC                                                      J508P2   238
           IF (ICKCGT.LE.1)GO TO 380                                        J508P2   239
           IF (ICKCGT.GE.2)GO TO 390                                        J508P2   240
240        GO TO (380,390),ICKCGT                                           J508P2   241
       380 H(I,J)=HP+((1./(2.*ROC))*((R(I)*SIN(THETA(J)-(PANG/2.)))**2))-BR2 J508P2   242
           GO TO 400                                                        J508P2   243
       390 BR3=((R(I)+R(M))/(2.*COS(PANG/2.)))-(R(I)*COS((PANG/2.)-THETA(J))) J508P2   244
           H(I,J)=HP-BR2+((1./(2.*ROC))*((BR3**2)+((R(I)*SIN((PANG/2.)-THETA( J508P2   245
245       *J)))**2)))                                                       J508P2   246
       400 CONTINUE                                                         J508P2   247
        85 CONTINUE                                                         J508P2   248
           GO TO 410                                                        J508P2   249
         C READ STEP INPUT                                                  J508P2   250
250     410 ICKCGT=IRS                                                      J508P2   251
           IF (ICKCGT.LE.1)GO TO 420                                        J508P2   252
           IF (ICKCGT.GE.2)GO TO 470                                        J508P2   253
           GO TO (420,470),ICKCGT                                           J508P2   254
       420 READ(IX,2240)PSD,PSA,ISTEP                                       J508P2   255
255        IF (COUNTER .EQ. 1 ) WRITE (IY,2250) PSD, PSA, ISTEP             J508P2   256
           PSA=PSA/CONDR                                                    J508P2   257
           IF (1.GT.M)GO TO 95                                              J508P2   258
           DO 460 I=1,M                                                     J508P2   259
           DO 460 J=1,N                                                     J508P2   260
260        IF (THETA(J)-PSA)430,430,460                                     J508P2   261
       430 ICKCGT=ISTEP                                                     J508P2   262
           IF (ICKCGT.LE.1)GO TO 440                                        J508P2   263
           IF (ICKCGT.GE.2)GO TO 450                                        J508P2   264
           GO TO (440,450),ICKCGT                                           J508P2   265
265    440 H(I,J)=H(I,J)+PSD-(PSD*THETA(J)/PSA)                             J508P2   266
           GO TO 460                                                        J508P2   267
       450 H(I,J)=H(I,J)+PSD                                                J508P2   268
       460 CONTINUE                                                         J508P2   269
        95 CONTINUE                                                         J508P2   270
270      C READ CHAMFER                                                     J508P2   271
       470 ICKCGT=ICHAM                                                     J508P2   272
           IF (ICKCGT.LE.1)GO TO 480                                        J508P2   273
           IF (ICKCGT.GE.2)GO TO 560                                        J508P2   274
           GO TO (480,560),ICKCGT                                           J508P2   275
275    480 READ(IX,2260)PANG1,PANG2,D1,D2,CHAM1,CHAM2                       J508P2   276
           PANG1=PANG1/CONDR                                                J508P2   277
           PANG2=PANG2/CONDR                                                J508P2   278
           PANG22=PANG-PANG2                                                J508P2   279
           IF (1.GT.M)GO TO 105                                             J508P2   280
280        DO 510 I=1,M                                                     J508P2   281
           DO 510 J=1,N                                                     J508P2   282
           IF (THETA(J)-PANG1)490,490,510                                   J508P2   283
       490 H(I,J)=HP+(R(I)*SIN(PANG1-THETA(J))-D1)*CHAM1                    J508P2   284
           IF (H(I,J)-HP)500,500,510                                        J508P2   285
285    500 H(I,J)=HP                                                        J508P2   286
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      510 CONTINUE                                                          J508P2  287
      105 CONTINUE                                                          J508P2  288
          IF (I.GT.M)GO TO 115                                              J508P2  289
          DO 540 I=1,M                                                      J508P2  290
290       DO 540 J=1,N                                                      J508P2  291
          IF (THETA(J)-PANG22)540,540,520                                   J508P2  292
      520 H(I,J)=HP+(R(I)*SIN(THETA(J)-PANG22)-D2)*CHAM2                     J508P2  293
          IF (H(I,J)-HP)530,530,540                                         J508P2  294
      530 H(I,J)=HP                                                         J508P2  295
295   540 CONTINUE                                                          J508P2  296
      115 CONTINUE                                                          J508P2  297
          IF (I.GT.M)GO TO 125                                              J508P2  298
          DO 550 I=1,M                                                      J508P2  299
          DO 550 J=1,N                                                      J508P2  300
300   550 H(I,J)=H(I,J)-((R(I)-RP)*COS(THETA(J)-TP)*PHIR)-(R(I)*SIN(THETA(J)  J508P2  301
         +-IP)*PHIT)                                                        J508P2  302
      125 CONTINUE                                                          J508P2  303
      560 ICKCGT=IRM                                                        J508P2  304
          IF (ICKCGT.LE.1)GO TO 570                                         J508P2  305
305       IF (ICKCGT.GE.2)GO TO 580                                         J508P2  306
          GO TO (570,580),ICKCGT                                            J508P2  307
C     READ CLEARANCES                                                       J508P2  308
      570 READ (IX,2270) I, J, H(I,J), NEXT, NTRANS(I,J)                    J508P2  309
          H(I,J)=H(I,J)+HP                                                  J508P2  310
310       ICKCGT=NEXT                                                       J508P2  311
          IF (ICKCGT.LE.1)GO TO 570                                         J508P2  312
          IF (ICKCGT.GE.2)GO TO 580                                         J508P2  313
          GO TO (570,580),ICKCGT                                            J508P2  314
C                                                                           J508P2  315
315   C     READ CLEARANCE FROM BOSS1 RESULT                                J508P2  316
      580 REWIND 65                                                         J508P2  317
C     FIRST, READ MAX. PERMISSIBLE H                                        J508P2  318
          READ (IX,2000) QQQIN                                              J508P2  319
      572 READ(65,2271) NBOSS,UZ(NBOSS)                                     J508P2  320
320  2271 FORMAT ( 1X, I5, F14.8)                                           J508P2  321
          IF(EOF(65)) 2272,572                                              J508P2  322
     2272 SAVEH1= QQQIN                                                     J508P2  323
          QZZWW= 1.E60                                                      J508P2  324
          DO 2273 NC=1,N                                                    J508P2  325
325       DO 2273 MC=1,M                                                    J508P2  326
          I=      (N + NBARQQ) * (MC - 1) + NC                              J508P2  327
          IF (NTRANS(1,1) .NE. 0)  I= NTRANS(MC,NC)                         J508P2  328
          H(MC,NC)= UZ(I) + H(MC,NC)                                        J508P2  329
          IF ( H(MC,NC) .GT. SAVEH1 ) PRINT 9872, MC, NC                    J508P2  330
330       IF ( H(MC,NC) .GT. SAVEH1 ) H(MC,NC) = SAVEH1                     J508P2  331
     9872 FORMAT ( 20H H RESET FOR MC,NC=   215 )                           J508P2  332
          QZZWW= AMIN1 (QZZWW, H(MC,NC) )                                   J508P2  333
     2273 CONTINUE                                                          J508P2  334
C                                                                           J508P2  335
335   C     SHIFT ALL H IF QZZWW .LT. HP                                    J508P2  336
C                                                                           J508P2  337
          IF ( QZZWW .GE. HP) GO TO 12300                                   J508P2  338
          QZZWW= HP - QZZWW                                                 J508P2  339
          DO 12200 NC=1,N                                                   J508P2  340
340       DO 12200 MC=1,M                                                   J508P2  341
     12200 H(MC,NC)= H(MC,NC) + QZZWW                                       J508P2  342
          PRINT 22200 , QZZWW, HP                                           J508P2  343
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      22200 FORMAT (19H04LL H INCREASED BY , E12.4,16H TO HAVE MIN(H)= E12.4/)  J508P2   344
      12300 CONTINUE                                                           J508P2   345
345         REWIND 65                                                          J508P2   346
      C     MODIFY CLEARANCES FOR NUTATION                                     J508P2   347
            ICKCGT=IRN                                                         J508P2   348
            IF (ICKCGT.LE.1)GO TO 590                                          J508P2   349
            IF (ICKCGT.GE.2)GO TO 610                                          J508P2   350
350         GO TO (590,610),ICKCGT                                             J508P2   351
        590 IF (1.GT.M)GO TO 135                                               J508P2   352
            DO 600 I=1,M                                                       J508P2   353
            DO 600 J=1,N                                                       J508P2   354
        600 H(I,J)=H(I,J)-(R(I)*COS(THETA(J)-AITO)*BETA)                       J508P2   355
355     135 CONTINUE                                                           J508P2   356
        610 IF (2.GT.M1)GO TO 145                                              J508P2   357
            DO 620 I=2,M1                                                      J508P2   358
            IN=I+1                                                             J508P2   359
            IM=I-1                                                             J508P2   360
360         DELRA(I)=R(I)-R(IM)                                                J508P2   361
            DELRB(I)=(R(IN)-R(I))                                              J508P2   362
            DEN1=DELRA(I)*(DELRA(I)+DELRB(I))*DELRB(I)                         J508P2   363
            QLR(I)=-((DELRB(I)*DELRB(I))/DEN1)                                 J508P2   364
            QMR(I)=((DELRB(I)*DELRA(I))-(DELRA(I)*DELRA(I)))/DEN1              J508P2   365
365     620 QRR(I)=(DELRA(I)*DELRA(I))/DEN1                                    J508P2   366
        145 CONTINUE                                                           J508P2   367
            DEN2=DELRA(M1)*(DELRA(M1)+DELRB(M1))*DELRB(M1)                     J508P2   368
            RLR=(DELRB(M1)*DELRB(M1))/DEN2                                     J508P2   369
            RMR=-(((DELRA(M1)+DELRA(M1))**2.)/DEN2)                            J508P2   370
370         RRR=(DELRA(M1)*(DELRA(M1)+(2.*DELRB(M1))))/DEN2                    J508P2   371
            DEN4=DELRA(2)*(DELRA(2)+DELRB(2))*DELRB(2)                         J508P2   372
            PLR=-(((2.*DELRA(2))+DELRB(2))*DELRB(2))/DEN4                      J508P2   373
            PMR=((DELRA(2)+DELRB(2))**2.)/DEN4                                 J508P2   374
            PRR=-((DELRA(2)*DELRA(2))/DEN4)                                    J508P2   375
375         DELRA(1)=0.                                                        J508P2   376
            DELRB(1)=DELRA(2)                                                  J508P2   377
            DELRA(M)=DELRB(M1)                                                 J508P2   378
            DELRB(M)=0.                                                        J508P2   379
            IF (1.GT.M)GO TO 155                                               J508P2   380
380         DO 630 I=1,M                                                       J508P2   381
            DO 630 J=2,NN                                                      J508P2   382
            DELTA(I,J)=ABS((R(I)*THETA(J))-(R(I)*THETA(J-1)))                  J508P2   383
            DELTB(I,J)=ABS((R(I)*THETA(J+1))-(R(I)*THETA(J)))                  J508P2   384
            DEN3=DELTA(I,J)*(DELTA(I,J)+DELTB(I,J))*DELTB(I,J)                 J508P2   385
385         QLT(I,J)=-((DELTB(I,J)*DELTB(I,J))/DEN3)                           J508P2   386
            QMT(I,J)=((DELTB(I,J)*DELTB(I,J))-(DELTA(I,J)*DELTA(I,J)))/DEN3    J508P2   387
        630 QRT(I,J)=(DELTA(I,J)*DELTA(I,J))/DEN3                              J508P2   388
        155 CONTINUE                                                           J508P2   389
            IF (1.GT.M)GO TO 165                                               J508P2   390
390         DO 640 I=1,M                                                       J508P2   391
            DELTB(I,1)=DELTA(I,2)                                              J508P2   392
            DELTA(I,1)=0.                                                      J508P2   393
            DELTA(I,N)=DELTB(I,NN)                                             J508P2   394
        640 DELTB(I,N)=0.                                                      J508P2   395
395     165 CONTINUE                                                           J508P2   396
            IF (ICEC-1)670,650,670                                             J508P2   397
        650 IF (1.GT.M)GO TO 175                                               J508P2   398
            DO 660 I=1,M                                                       J508P2   399
            DELTA(I,1)=ABS(R(I)*(PANG-THETA(N)))                               J508P2   400
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      660 DELTB(I,N)=ABS(R(I)*(PANG-THETA(N)))                          J508P2   401
      175 CONTINUE                                                      J508P2   402
      670 IF (1.GT.M)GO TO 185                                          J508P2   403
          DO 680 I=1,M                                                  J508P2   404
          DEN6=DELTA(I,NN)*(DELTA(I,NN)+DELTB(I,NN))*DELTB(I,NN)        J508P2   405
          RLT(I)=DELTB(I,NN)**2/DEN6                                    J508P2   406
          RMT(I)=-((DELTA(I,NN)+DELTB(I,NN))**2)/DEN6                   J508P2   407
          RRT(I)=DELTA(I,NN)*(DELTA(I,NN)+(2.*DELTB(I,NN)))/DEN6        J508P2   408
          DEN8=DELTA(I,2)*(DELTA(I,2)+DELTB(I,2))*DELTB(I,2)            J508P2   409
          PLT(I)=-(((2.*DELTA(I,2))+DELTB(I,2))*DELTB(I,2))/DEN8        J508P2   410
          PMT(I)=((DELTA(I,2)+DELTB(I,2))**2)/DEN8                      J508P2   411
      680 PRT(I)=-(DELTA(I,2)**2)/DEN8                                  J508P2   412
      185 CONTINUE                                                      J508P2   413
C         FORM MATRICES FOR PRESSURE ITERATION                          J508P2   414
          IF (1.GT.M)GO TO 195                                          J508P2   415
          DO 760 I=1,M                                                  J508P2   416
          DO 760 J=1,N                                                  J508P2   417
          RE(I,J)=(H(I,J)*R(I)*S*RHO)/U9                                J508P2   418
          IF (RE(I,J)-RECR)690,700,700                                  J508P2   419
      690 RK=12.                                                        J508P2   420
          TK=12.                                                        J508P2   421
          CODE(I,J)=1.                                                  J508P2   422
          GO TO 710                                                     J508P2   423
      700 RK=12.+(0.296*((CONK*CONK*RE(I,J))**0.65))                    J508P2   424
          TK=12.+(0.53*((CONK*CONK*RE(I,J))**0.725))                    J508P2   425
          CODE(I,J) = 2.                                                J508P2   426
      710 RKP(I,J) = ((H(I,J)**3.)*R(I))/(RK*U9)                        J508P2   427
          TKP(I,J) = (H(I,J)**3.)/(TK*U9)                               J508P2   428
          DIFV(I,J) = MOD-(BETAD*R(I)*COS(THETA(J)-AITO))-(R(I)*PSID*BETA* J508P2   429
         +SIN(THETA(J)-AITO))                                           J508P2   430
          IF (J-1) 730,720,730                                          J508P2   431
      720 PAHTH(I,1) = (PLT(I)*H(I,1))+(PMT(I)*H(I,2))+(PRT(I)*H(I,3))  J508P2   432
          GO TO 760                                                     J508P2   433
      730 IF (J-N) 750,740,750                                          J508P2   434
      740 PAHTH(I,N) = (RLT(I)*H(I,N-2))+(RMT(I)*H(I,N-1))+(RRT(I)*H(I,N)) J508P2 435
          GO TO 760                                                     J508P2   436
      750 PAHTH(I,J) = (QLT(I,J)*H(I,J-1))+(QMT(I,J)*H(I,J))+(QRT(I,J)*H(I, J508P2 437
         +J+1))                                                         J508P2   438
          RKCF(I,J) = (R(I)*R(I)*H(I,J)**3.)/U9                         J508P2   439
      760 RHS(I,J) = DIFV(I,J)+((S*R(I)/2.)*PAHTH(I,J))                 J508P2   440
      195 CONTINUE                                                      J508P2   441
          IF (1.GT.M) GO TO 205                                         J508P2   442
          DO 770 I = 1,M                                                J508P2   443
          DO 770 J = 1,N                                                J508P2   444
          FI(I,J) = 0.                                                  J508P2   445
      770 FR(I,J) = 0.                                                  J508P2   446
      205 CONTINUE                                                      J508P2   447
          ICKCGT = MPRT                                                 J508P2   448
          IF (ICKCGT.LE.1) GO TO 780                                    J508P2   449
          IF (ICKCGT.GE.2) GO TO 800                                    J508P2   450
          GO TO (780,800),ICKCGT                                        J508P2   451
      780 IF (1.GT.M) GO TO 215                                         J508P2   452
          DO 790 I = 1,M                                                J508P2   453
          WRITE (IY,2370) I                                             J508P2   454
          WRITE (IY,2280)                                               J508P2   455
          WRITE (IY,2290) (J,H(I,J),P(I,J),IP(I,J),J = 1,N)             J508P2   456
      790 CONTINUE                                                      J508P2   457
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      215 CONTINUE                                                          J508P2   458
C         SOLUTION OF FINITE DIFFERENCE EQUATIONS FOR PRESSURES             J508P2   459
          KINERT = 1                                                        J508P2   460
460       800 ITERP = 0                                                     J508P2   461
              ITERC = 0                                                     J508P2   462
              SERDT = 0.                                                    J508P2   463
              SERDR = 0.                                                    J508P2   464
              IEXTC = 0                                                     J508P2   465
465           IF (1.GT.M) GO TO 225                                         J508P2   466
              DO 810 I = 1,M                                                J508P2   467
              DO 810 J = 1,N                                                J508P2   468
              OP(I,J) = 0.                                                  J508P2   469
          810 OOP(I,J) = 0.                                                 J508P2   470
470       225 CONTINUE                                                      J508P2   471
          820 SERDP = 0.                                                    J508P2   472
              SUMP = 0.                                                     J508P2   473
              BERR = 0.                                                     J508P2   474
              BPADP = 0.                                                    J508P2   475
475           KPRESS = 1                                                    J508P2   476
              IF (2.GT.M1) GO TO 235                                        J508P2   477
              DO 1280 I = 2,M1                                              J508P2   478
              DO 1280 J = IS,IE                                             J508P2   479
              IF (IP(I,J)-1) 830,1280,830                                   J508P2   480
480       830 IN = I+1                                                      J508P2   481
              IM = I-1                                                      J508P2   482
              JN = J+1                                                      J508P2   483
              JM = J-1                                                      J508P2   484
              DELT1 = DELTA(I,J)                                            J508P2   485
485           DELT2 = DELTB(I,J)                                            J508P2   486
              DELT3 = (DELT1+DELT2)/2.                                      J508P2   487
              DELR1 = DELRA(I)                                              J508P2   488
              DELR2 = DELRB(I)                                              J508P2   489
              DELR3 = (DELR1+DELR2)/2.                                      J508P2   490
490           IF (ICEC-1) 880,840,880                                       J508P2   491
          840 IF (J-1) 860,850,860                                          J508P2   492
          850 TERMA = ((TKP(I,JN)+TKP(I,J))/2.)*(P(I,JN)-(DELT2*((FT(I,JN)+FT(I,  J508P2   493
             +J))/2.)))                                                     J508P2   494
              TERMB = ((TKP(I,N)+TKP(I,J))/2.)*(P(I,N)+(DELT1*((FT(I,N)+FT(I,J))  J508P2   495
495          +/2.)))                                                        J508P2   496
              CHJ = ((((TKP(I,JN)+TKP(I,J))/2.)/DELT2)+(((TKP(I,N)+TKP(I,J))/2.)  J508P2   497
             +/DELT1))/DELT3                                                J508P2   498
              D = TKP(I,J)*((P(I,JN)-P(I,N))/(DELT1+DELT2))**2              J508P2   499
              F = ((H(I,J)*R(I)*S)/2.)*((P(I,JN)-P(I,N))/(DELT1+DELT2))     J508P2   500
500           GO TO 890                                                     J508P2   501
          860 IF (J-N) 880,870,880                                          J508P2   502
          870 TERMA = ((TKP(I,1)+TKP(I,J))/2.)*(P(I,1)-(DELT2*((FT(I,1)+FT(I,J))  J508P2   503
             +/2.)))                                                        J508P2   504
              TERMB = ((TKP(I,JM)+TKP(I,J))/2.)*(P(I,JM)+(DELT1*((FT(I,JM)+FT  J508P2   505
505          +(I,J))/2.)))                                                  J508P2   506
              CHJ = ((((TKP(I,1)+TKP(I,J))/2.)/DELT2)+(((TKP(I,JM)+TKP(I,J))/2.)  J508P2   507
             +/DELT1))/DELT3                                                J508P2   508
              D = TKP(I,J)*((P(I,1)-P(I,JM))/(DELT1+DELT2))**2              J508P2   509
              F = ((H(I,J)*R(I)*S)/2.)*((P(I,1)-P(I,JM))/(DELT1+DELT2))     J508P2   510
510           GO TO 890                                                     J508P2   511
          880 TERMA = ((TKP(I,JN)+TKP(I,J))/2.)*(P(I,JN)-(DELT2*((FT(I,JN)+FT  J508P2   512
             +(I,J))/2.)))                                                  J508P2   513
              TERMB = ((TKP(I,JM)+TKP(I,J))/2.)*(P(I,JM)+(DELT1*((FT(I,JM)+FT  J508P2   514
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     +(I,J))/2.)))                                                          J508P2   515
515      CHJ = ((((TKP(I,JN)+TKP(I,J))/2.)/DELT2)+(((TKP(I,JM)+TKP(I,J))    J508P2   516
     +/2.)/DELT1))/DELT3                                                    J508P2   517
         D = TKP(I,J)*((P(I,JN)-P(I,JM))/(DELT1+DELT2))**2                  J508P2   518
         F = ((R(I,J)*R(I)*S)/2.)*((P(I,JN)-P(I,JM))/(DELT1+DELT2))         J508P2   519
     890 TERM1 = ((TERMA/DELT2)+(TERMA/DELT1))/DELT3                        J508P2   520
520      TERMC = ((RKP(IN,J)+RKP(I,J))/2.)*(P(IN,J)-(DELR2*((FR(IN,J)+FR    J508P2   521
     +(I,J))/2.)))                                                          J508P2   522
         TERMD = ((RKP(IM,J)+RKP(I,J))/2.)*(P(IM,J)+(DELR1*((FR(IM,J)+FR    J508P2   523
     +(I,J))/2.)))                                                          J508P2   524
         TERM2 = ((TERMC/DELR2)+(TERMD/DELR1))/(DELR3*R(I))                 J508P2   525
525      CHI = ((((RKP(IN,J)+RKP(I,J))/2.)/DELR2)+(((RKP(IM,J)+RKP(I,J))/2. J508P2   526
     +)/DELR1))/DELR3                                                       J508P2   527
         OLOP = P(I,J)                                                      J508P2   528
C        PRECESS PRESSURE ARRAYS                                            J508P2   529
         OOP(I,J) = OP(I,J)                                                 J508P2   530
530      OP(I,J) = P(I,J)                                                   J508P2   531
         ICKCGT = INC                                                       J508P2   532
         IF (ICKCGT.LE.1) GO TO 1050                                        J508P2   533
         IF (ICKCGT.GE.2) GO TO 900                                         J508P2   534
         GO TO (1050,900),ICKCGT                                            J508P2   535
535      900 A = -RHS(I,J)                                                  J508P2   536
         CMCF =( RKCF(IN,J)-RKCF(IM,J))/(DELR1+DELR2)                       J508P2   537
         CMCF = (RKCF(IN,J)-RKCF(IM,J))/(DELR1+DELR2)                       J508P2   538
         CINER =S*S/(20.*RGAS*TGAS*R(I))                                    J508P2   539
         BB = CMCF*CINER/2.                                                 J508P2   540
540      EE = CINER*(RKCF(I,J)/R(I))*(P(IN,J)-P(IM,J))/(DELR1+DELR2)        J508P2   541
         B = -(BB+CHI/R(I)+CHJ)                                             J508P2   542
         E = -EE+TERM1+TERM2                                                J508P2   543
         C = TKP(I,J)*((P(IN,J)-P(IM,J))/(DELR1+DELR2))**2                  J508P2   544
         ITRT = ITRT+1                                                      J508P2   545
545      IF (IP(I,J)-3) 910,920,910                                         J508P2   546
     910 G = 0.                                                             J508P2   547
         GO TO 1000                                                         J508P2   548
     920 TE1 = (CD*AO*PS)/(DELT3*DELR3)                                     J508P2   549
         CORRO = (1.-ITRT/CORRE)                                            J508P2   550
550      IF (CORRO) 940,930,930                                             J508P2   551
     930 P(I,J) = PS*CORRO+P(I,J)*(1.-CORRO)                                J508P2   552
     940 IF (P(I,J)-PS) 950,980,980                                         J508P2   553
     950 IF (P(I,J)-(PS*CHOKT)) 960,960,970                                 J508P2   554
     960 BRA = (2./(SHR+1.))**(2./(SHR-1.))-(2./(SHR+1.))**((SHR+1.)/(SHR   J508P2   555
555      +-1.))                                                             J508P2   556
         GO TO 990                                                          J508P2   557
     970 BRA = ((P(I,J)/PS)**(2./SHR))-(P(I,J)/PS)**((SHR+1.)/SHR)          J508P2   558
         IF (BRA) 980,980,990                                               J508P2   559
     980 G = 0.                                                             J508P2   560
560      GO TO 1000                                                         J508P2   561
     990 G = TE1*SQRT(((2.*SHR*RGAS*TGAS)/(SHR-1.))*BRA)                    J508P2   562
    1000 RAD = (((E+A)/B)**2)-((4./B)*(C+D+G-F))                            J508P2   563
         IF (RAD) 1010,1020,1020                                            J508P2   564
    1010 RAD = 0.                                                           J508P2   565
565 1020 P(I,J) = (-((E+A)/B)+SQRT(RAD))/2.                                 J508P2   566
         IF (IP(I,J)-3) 1090,1030,1090                                      J508P2   567
    1030 IF (P(I,J)-PS) 1090,1040,1040                                      J508P2   568
    1040 P(I,J) = PS                                                        J508P2   569
         GO TO 1090                                                         J508P2   570
570      1050 IF (IP(I,J)-4) 1070,1060,1070                                 J508P2   571
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      1060 CAPB = (PI*(CAPD**4))/(128.*U9*CAPL)                                  J508P2   572
           GO TO 1080                                                            J508P2   573
      1070 CAPB = 0.                                                             J508P2   574
      1080 P(I,J) = (((CAPPS*CAPB)/(DELT3*DELR3))+TERM1+TERM2-RHS(I,J))/((CHI    J508P2   575
          +/R(I))+CHJ+(CAPB/(DELT3*DELR3)))                                      J508P2   576
      1090 IF (VAPP-P(I,J)) 1110,1260,1100                                       J508P2   577
      1100 P(I,J) = VAPP                                                         J508P2   578
           GO TO 1260                                                            J508P2   579
      1110 IF (P(I,J)-1.-VAPP) 1260,1120,1120                                    J508P2   580
      1120 DIFFP = ABS(P(I,J)-OLDP)                                              J508P2   581
           PADP = 0.                                                             J508P2   582
      1121 CONTINUE                                                              J508P2   583
           PADP = 0.                                                             J508P2   584
           IF (DIFFP .NE. 0.) PADP = ABS( DIFFP / (P(I,J) - AMBP) )              J508P2   585
           IF (BPADP-PADP) 1130,1140,1140                                        J508P2   586
      1130 II = I                                                                J508P2   587
           JJ = J                                                                J508P2   588
           BPADP = PADP                                                          J508P2   589
      1140 IF (PADP-.00001) 1260,1260,1150                                       J508P2   590
      1150 IF (OP(I,J)-VAPP-.5) 1260,1260,1160                                   J508P2   591
      1160 IF (OOP(I,J)-VAPP-.5) 1260,1260,1170                                  J508P2   592
      1170 IF (P(I,J)-VAPP-1.) 1260,1260,1180                                    J508P2   593
      1180 IF (OOP(I,J)-100000.) 1190,1230,1230                                  J508P2   594
     C*******************   CORRECTION FOR DIVIDE FAULT   ********************* J508P2   595
      1190 IF ((2.*OP(I,J))-P(I,J)-OOP(I,J)) 1210,1200,1210                      J508P2   596
      1200 PEXT = .25*((2.*OP(I,J))+P(I,J)+OOP(I,J))                             J508P2   597
           GO TO 1220                                                            J508P2   598
      1210 PEXT = 0.25*(((2.*OP(I,J))+P(I,J)+OOP(I,J))+(((P(I,J)-OOP(I,J))**2   J508P2   599
          +)/((2.*OP(I,J))-P(I,J)-OOP(I,J))))                                    J508P2   600
      1220 CONTINUE                                                              J508P2   601
     C*************************************************************************** J508P2   602
           ERR = ABS((PEXT-P(I,J))/P(I,J))                                       J508P2   603
           IF (ERR-(.5*ERROP)) 1230,1230,1240                                    J508P2   604
      1230 OP(I,J) = 1000000.                                                    J508P2   605
           GO TO 1260                                                            J508P2   606
      1240 IF (BERR-ERR) 1250,1260,1260                                          J508P2   607
      1250 BERR = ERR                                                            J508P2   608
           III = I                                                               J508P2   609
           JJJ = J                                                               J508P2   610
      1260 IF (ABS(RELAX-1.)-.001) 1280,1280,1270                                J508P2   611
      1270 ADIFP = P(I,J)-OLDP                                                   J508P2   612
           P(I,J) = (ADIFP*RELAX)+OLDP                                           J508P2   613
      1280 CONTINUE                                                              J508P2   614
       235 CONTINUE                                                              J508P2   615
           ITERT = ITERT+1                                                       J508P2   616
           ITERP = ITERP+1                                                       J508P2   617
           ITERC = ITERC+1                                                       J508P2   618
           IEXTC = IEXTC+1                                                       J508P2   619
           IF (IEXTC-IEXT) 820,1290,1290                                         J508P2   620
      1290 IF (BPADP-ERROP) 1300,1300,1310                                       J508P2   621
      1300 IF (BERR-ERROP) 1330,1330,1310                                        J508P2   622
      1310 IF (ITERP-LP) 820,1320,1320                                           J508P2   623
      1320 KPRESS = 2                                                            J508P2   624
           IF (INERT-1)1590,1330,1590                                            J508P2   625
      1330 IF (KINERT-2)1340,1590,1590                                           J508P2   626
      1340 IF (I.GT.M)GO TO 245                                                  J508P2   627
           DO 1440 I=1,M                                                         J508P2   628
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      C     CALCULATE DU/DT AND DW/DT FOR LAMINAR FLOW                          J508P2   629
            DO 1440 J=1,N                                                       J508P2   630
  630       IF (J-1)1360,1350,1360                                              J508P2   631
     1350   PAPTH(I,1)=(PLT(I)*P(I,1))+(PMT(I)*P(I,2))+(PRT(I)*P(I,3))          J508P2   632
            GO TO 1390                                                          J508P2   633
     1360   IF (J-N)1380,1370,1380                                              J508P2   634
     1370   PAPTH(I,N)=(RLT(I)*P(I,N-2))+(RMT(I)*P(I,N-1))+(RRT(I)*P(I,N))      J508P2   635
  635       GO TO 1390                                                          J508P2   636
     1380   PAPTH(I,J)=(QLT(I,J)*P(I,J-1))+(QMT(I,J)*P(I,J))+(QRT(I,J)*P(I,J+1 J508P2   637
           +))                                                                  J508P2   638
     1390   IF (I-1)1410,1400,1410                                              J508P2   639
     1400   PAPR(I,J)=(PLR*P(1,J))+(PMR*P(2,J))+(PRR*P(3,J))                    J508P2   640
  640       GO TO 1440                                                          J508P2   641
     1410   IF (I-M)1430,1420,1430                                              J508P2   642
     1420   PAPR(I,J)=(RLR*P(M-2,J))+(RMR*P(M-1,J))+(RRR*P(M,J))                J508P2   643
            GO TO 1440                                                          J508P2   644
     1430   PAPR(I,J)=(QLR(I)*P(I-1,J))+(QMR(I)*P(I,J))+(QRR(I)*P(I+1,J))       J508P2   645
  645       CONTINUE                                                            J508P2   646
      245   CONTINUE                                                            J508P2   647
            IF (1.GT.M)GO TO 255                                                J508P2   648
            DO 1450 I=1,M                                                       J508P2   649
            DO 1450 J=1,N                                                       J508P2   650
  650       PTR(I,J)=PAPTH(I,J)-FT(I,J)                                         J508P2   651
     1450   PDR(I,J)=PAPR(I,J)-FR(I,J)                                          J508P2   652
      255   CONTINUE                                                            J508P2   653
            IF (INERT-1)1590,1460,1590                                          J508P2   654
     1460   IF (1.GT.M)GO TO 265                                                J508P2   655
  655       DO 1570 I=1,M                                                       J508P2   656
            DO 1570 J=1,N                                                       J508P2   657
            IF (J-1)1480,1470,1480                                              J508P2   658
     1470   PAPTT=(PLT(I)*PTR(I,1))+(PMT(I)*PTR(I,2))+(PRT(I)*PTR(1,3))         J508P2   659
            PAPDT=(PLT(I)*PDR(I,1))+(PMT(I)*PDR(I,2))+(PRT(I)*PDR(I,3))         J508P2   660
  660       GO TO 1510                                                          J508P2   661
     1480   IF (J-N)1500,1490,1500                                              J508P2   662
     1490   PAPTT=(RLT(I)*PTR(I,N-2))+(RMT(I)*PTR(I,N-1))+(RRT(I)*PTR(I,N))     J508P2   663
            PAPDT=(RLT(I)*PDR(I,N-2))+(RMT(I)*PDR(I,N-1))+(RRT(I)*PDR(I,N))     J508P2   664
            GO TO 1510                                                          J508P2   665
  665       1500 PAPTT=(QLT(I,J)*PTR(I,J-1))+(QMT(I,J)*PTR(I,J))+(QRT(I,J)*PTR(I,J+ J508P2   666
           +1))                                                                 J508P2   667
            PAPDT=(QLT(I,J)*PDR(I,J-1))+(QMT(I,J)*PDR(I,J))+(QRT(I,J)*PDR(I,J+ J508P2   668
           +1))                                                                 J508P2   669
     1510   IF (I-1)1530,1520,1530                                              J508P2   670
  670       1520 PAPTH=(PLR*PTH(1,J))+(PMR*PTR(2,J))+(PRR*PTR(3,J))             J508P2   671
            PAPDR=(PLR*PDR(1,J))+(PMR*PDR(2,J))+(PRR*PDR(3,J))                  J508P2   672
            PAHR=(PLR*H(1,J))+(PMR*H(2,J))+(PRR*H(3,J))                         J508P2   673
            GO TO 1560                                                          J508P2   674
     1530   IF (I-M)1550,1540,1550                                              J508P2   675
  675       1540 PAPTH=(RLR*PTR(M-2,J))+(RMR*PTR(M-1,J))+(RRR*PTR(M,J))         J508P2   676
            PAPDR=(RLR*PDR(M-2,J))+(RMR*PDR(M-1,J))+(RRR*PDR(M,J))              J508P2   677
            PAHR=(RLR*H(M-2,J))+(RMR*H(M-1,J))+(RRR*H(M,J))                     J508P2   678
            GO TO 1560                                                          J508P2   679
     1550   PAPTH=(QLR(I)*PTR(I-1,J))+(QMR(I)*PTR(I,J))+(QRR(I)*PTR(I+1,J))     J508P2   680
  680       PAPDR=(QLR(I)*PDR(I-1,J))+(QMR(I)*PDR(I,J))+(QRR(I)*PDR(I+1,J))     J508P2   681
            PAHR=(QLR(I)*H(I-1,J))+(QMR(I)*H(I,J))+(QRR(I)*H(I+1,J))            J508P2   682
     1560   DU1=(R(I)*S)/(8.*U9)*PDR(I,J)*PAHR                                  J508P2   683
            DU2=((H(I,J)*H(I,J)*S)/(12.*U9))*PAPTT                              J508P2   684
            DU3=(((H(I,J)**2/U9)**2)/60.)*PTR(I,J)*PAPTT                        J508P2   685
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                DU4=((R(I)*S)**2/(3.*H(I,J)))*PAHTH(I,J)                                J508P2   686
                HUT1=((H(I,J)/U9)**2.)*(H(I,J)/24.)                                     J508P2   687
                DU5=HUT1*PDR(I,J)*PTR(I,J)*PAHR                                         J508P2   688
                DU6=HUT1*PTR(I,J)*PTR(I,J)*PAHTH(I,J)                                   J508P2   689
                HUT2=((H(I,J)**2/U9)**2)/120.                                           J508P2   690
      690       DU7=HUT2*PDR(I,J)*PAPTR                                                 J508P2   691
                DU8=PAPDR*((HUT2*PTR(I,J))-((R(I)*S*H(I,J)*H(I,J))/(24.*U9)))           J508P2   692
                DU9=((R(I)*S)/(2.*H(I,J))-((H(I,J)/(4.*U9))*PTR(I,J)))*DIFV(I,J)        J508P2   693
                DU10=((S*H(I,J)*R(I))/(4.*U9))*PTR(I,J)*PAHTH(I,J)                      J508P2   694
                DUDT=DU3-DU1-DU2+DU4+DU5+DU6+DU7+DU8-DU9-DU10                           J508P2   695
      695       DW1=((HUT1*PTR(I,J))-((H(I,J)*S*R(I))/(8.*U9)))*PDR(I,J)*PAHTH(I,J     J508P2   696
                +)                                                                      J508P2   697
                DW2=((HUT2*PTR(I,J))-((H(I,J)*H(I,J)*S)/(24.*U9)))*PAPDT                J508P2   698
                DW3=HUT2*PDR(I,J)*PAPTT                                                 J508P2   699
                DW4=(PDR(I,J)**2)*HUT1*PAHR                                             J508P2   700
      700       DW5=2.*HUT2*PDR(I,J)*PAPDR                                              J508P2   701
                DW6=0.                                                                  J508P2   702
                DW7=(HUT2/R(I))*((PTR(I,J)**2)+(PDR(I,J)**2))                           J508P2   703
                DW8=(S*H(I,J)*H(I,J))/(12.*U9)*PTR(I,J)                                 J508P2   704
                DW9=(H(I,J)/(4.*U9))*PDR(I,J)*DIFV(I,J)                                 J508P2   705
      705       DWDT=DW1+DW2+DW3+DW4+DW5-DW6+DW7+DW8-DW9                                J508P2   706
                RHO=P(I,J)/RGAS/TGAS                                                    J508P2   707
                TEMP1=(RHO*DUDT)+PAPTH(I,J)                                             J508P2   708
                UBAR(I,J)=((R(I)*S)/2.)-(((H(I,J)**2.)/(12.*U9))*TEMP1)                 J508P2   709
                TEMP2=(RHO*DWDT)+PAPR(I,J)                                              J508P2   710
      710       WBAR(I,J)=(-1.)*((H(I,J)**2.)/(12.*U9))*TEMP2                           J508P2   711
                FROLD=FR(I,J)                                                           J508P2   712
                FR(I,J)=-(RHO*DWDT)                                                     J508P2   713
                DIFFR=ABS(FR(I,J)-FROLD)                                                J508P2   714
                PADFR=ABS(DIFFR/FR(I,J))                                                J508P2   715
      715       SERDR=SERDR+PADFR                                                       J508P2   716
                FTOLD=FT(I,J)                                                           J508P2   717
                FT(I,J)=-(RHO*DUDT)                                                     J508P2   718
                DIFFT=ABS(FT(I,J)-FTOLD)                                                J508P2   719
                PADFT=ABS(DIFFT/FT(I,J))                                                J508P2   720
      720       SERDT=SERDT+PADFT                                                       J508P2   721
             1570 CONTINUE                                                              J508P2   722
              265 CONTINUE                                                              J508P2   723
                ITER1=ITER1+1                                                           J508P2   724
                IF (ITER1-L1)800,1580,1580                                              J508P2   725
      725       1580 KINEMT=2                                                           J508P2   726
                GO TO 800                                                               J508P2   727
             C  CALCULATION OF FINAL RESULTS                                            J508P2   728
              1590 FM0=0.                                                               J508P2   729
                FM1=0.                                                                  J508P2   730
      730       IF (1.GT.M)GO TO 275                                                    J508P2   731
                DO 1740 I=1,M                                                           J508P2   732
                DO 1740 J=1,N                                                           J508P2   733
                IF (CODE(I,J)-1.)1600,1670,1600                                         J508P2   734
              1600 KNT=0                                                                J508P2   735
      735       TF1=(H(I,J)*CONK*RHO)/(2.*U9)                                           J508P2   736
                TF2=(CONK*R(I)*S/2.)                                                    J508P2   737
                STAR0=SQRT(((U9*R(I)*S)/(2.*RHO*H(1,1))))                               J508P2   738
              1610 STAN=ALOG(TF1*STAR0)-(TF2/STAR0)+1.                                  J508P2   739
                STAD=(1./STAR0)+(TF2/(STAR0*STAR0))                                     J508P2   740
      740       VSTAR=STAR0-(STAN/STAD)                                                 J508P2   741
                IF (VSTAR)1620,1630,1630                                                J508P2   742
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      1620 VSTAR=SQRT((U9*R(I)*S)/H(I,J))                                    J508P2   743
           GO TO 1660                                                        J508P2   744
      1630 DIFST=ABS(VSTAR-STAR0)                                            J508P2   745
745        STAR0=VSTAR                                                       J508P2   746
           IF ((DIFST/VSTAR)-0.02)1660,1660,1640                             J508P2   747
      1640 KNT=KNT+1                                                         J508P2   748
           IF (KNT-75)1610,1650,1650                                         J508P2   749
      1650 KFRIC=2                                                           J508P2   750
750        FM0=0.                                                            J508P2   751
           FM1=0.                                                            J508P2   752
           GO TO 1750                                                        J508P2   753
      1660 TEM=(H(I,J)/2.)*PTR(I,J)                                          J508P2   754
           T0=(VSTAR*VSTAR*RHO)-TEM                                          J508P2   755
755        T1=(VSTAR*VSTAR*RHO)-TEM                                          J508P2   756
           GO TO 1680                                                        J508P2   757
      1670 TEM=(H(I,J)/2.)*PTR(I,J)                                          J508P2   758
           T0=((U9*R(I)*S)/H(I,J))-TEM                                       J508P2   759
           T1=((U9*R(I)*S)/H(I,J))+TEM                                       J508P2   760
760   1680 IF (I-1)1710,1690,1710                                            J508P2   761
      1690 DRDTC=((DELTA(I,J)+DELTB(I,J))*DELRA(2))/4.                       J508P2   762
      1700 FM0=(T0*R(I)*DRDTC)+FM0                                           J508P2   763
           FM1=(T1*R(I)*DRDTC)+FM1                                           J508P2   764
           GO TO 1740                                                        J508P2   765
765   1710 IF (I-M)1730,1720,1730                                            J508P2   766
      1720 DRDTC=((DELTA(I,J)+DELTB(I,J))*DELRB(M1))/4.                      J508P2   767
           GO TO 1700                                                        J508P2   768
      1730 DRDTC=((DELTA(I,J)+DELTB(I,J))*(DELRA(I)+DELRB(I)))/4.            J508P2   769
           GO TO 1700                                                        J508P2   770
770   1740 CONTINUE                                                          J508P2   771
       275 CONTINUE                                                          J508P2   772
      1750 IF (INERT-1)1760,1810,1760                                        J508P2   773
      1760 IF (I.GT.M)GO TO 285                                              J508P2   774
           DO 1800 I=1,M                                                     J508P2   775
775        DO 1800 J=1,N                                                     J508P2   776
           IF (RE(I,J)-RECR)1770,1780,1780                                   J508P2   777
      1770 RK=12.                                                            J508P2   778
           TK=12.                                                            J508P2   779
           GO TO 1790                                                        J508P2   780
780   1780 RK=12.+(0.294*((CONK*CONK*RE(I,J))**0.65))                        J508P2   781
           TK=12.+(0.53*((CONK*CONK*RE(I,J))**0.725))                        J508P2   782
      1790 UBAR(I,J)=((-1.)*((H(I,J)**2.)/(U9*TK))*PTR(I,J))+((R(I)*S)/2.)   J508P2   783
      1800 WBAR(I,J)=(-1.)*((H(I,J)**2.)/(U9*RK))*PDR(I,J)                   J508P2   784
       285 CONTINUE                                                          J508P2   785
785   1810 SFT=0.                                                            J508P2   786
           SFTB=0.                                                           J508P2   787
           SMC=0.                                                            J508P2   788
           SMCB=0.                                                           J508P2   789
           SMS=0.                                                            J508P2   790
790        SMSB=0.                                                           J508P2   791
           IF (I.GT.M)GO TO 295                                              J508P2   792
           DO 1820 I=1,M                                                     J508P2   793
           DO 1820 J=1,N                                                     J508P2   794
      1820 P(I,J)=P(I,J)-AMBP                                                J508P2   795
795    295 CONTINUE                                                          J508P2   796
           IF (2.GT.M1)GO TO 305                                             J508P2   797
           DO 1830 I=2,M1                                                    J508P2   798
           DO 1830 J=1,N                                                     J508P2   799
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62500

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                DELTR=((DELTA(I,J)+DELTB(I,J))*(DELRA(I)+DELRB(I)))/4.                  J508P2   800
      800       SFT=(P(I,J)*DELTR)+SFT                                                  J508P2   801
                SMC=(P(I,J)*((R(I)*COS(THETA(J)))-R(1))*DELTR)+SMC                      J508P2   802
     1870       SMS=(P(I,J)*((R(I)*SIN(THETA(J)))*DELTR))+SMS                           J508P2   803
      305       CONTINUE                                                                J508P2   804
                IF (1.GT.N)GO TO 315                                                    J508P2   805
      805       DO 1840 J=1,N                                                           J508P2   806
                DELTR=((DELTA(1,J)+DELTB(1,J))*DELRA(2))/4.                             J508P2   807
                DEMTR=((DELTA(M,J)+DELTB(M,J))*DELRB(M1))/4.                            J508P2   808
                SFTB=(P(1,J)*DELTR)+(P(M,J)*DEMTR)+SFTB                                 J508P2   809
                SMCB=(P(I,J)*((R(1)*COS(THETA(J)))-R(1))*DELTR)+(P(M,J)*((R(M)*COS      J508P2   810
      810      *(THETA(J)))-R(1))*DEMTR)+SMCB                                          J508P2   811
     1840       SMSB=(P(1,J)*(R(1)*SIN(THETA(J)))*DELTR)+(P(M,J)*(R(M)*SIN(THETA(J      J508P2   812
               *)))*DEMTR)+SMSB                                                         J508P2   813
      315       CONTINUE                                                                J508P2   814
                IF (1.GT.M)GO TO 325                                                    J508P2   815
      815       DO 1850 I=1,M                                                           J508P2   816
                DO 1850 J=1,N                                                           J508P2   817
     1850       P(I,J)=P(I,J)+AMBP                                                      J508P2   818
      325       CONTINUE                                                                J508P2   819
                TFT=SFT+SFTB                                                            J508P2   820
      820       CM=SCM=SMCB                                                             J508P2   821
                SM=SMS+SMSB                                                             J508P2   822
                THETC=ATAN(SM/(CM+(R(1)*TFT)))                                          J508P2   823
                RC=SM/(TFT*SIN(THETC))                                                  J508P2   824
                QR2=0.                                                                  J508P2   825
      825       QRM1=0.                                                                 J508P2   826
                IF (1.GT.N)GO TO 335                                                    J508P2   827
                DO 1860 J=1,N                                                           J508P2   828
                QR2=((WBAR(2,J)*H(2,J))*((DELTA(2,J)+DELTB(2,J))/2.))+QR2               J508P2   829
     1860       QRM1=((WBAR(M1,J)*H(M1,J))*((DELTA(M1,J)+DELTB(M1,J))/2.))+QRM1         J508P2   830
      830       335 CONTINUE                                                            J508P2   831
                QC2=0.                                                                  J508P2   832
                IF (1.GT.M)GO TO 345                                                    J508P2   833
                DO 1870 I=1,M                                                           J508P2   834
     1870       QC2=((UBAR(I,2)*H(I,2))*((DELRA(I)+DELRB(I))/2.))+QC2                   J508P2   835
      835       345 CONTINUE                                                            J508P2   836
                FM0HP=(FM0*S)/6600.                                                     J508P2   837
                FW0=(2545./3.413)*FM0HP                                                 J508P2   838
                FM1HP=(FM1*S)/6600.                                                     J508P2   839
                FW1=(2545./3.413)*FM1HP                                                 J508P2   840
      840       THETC=THETC*CONDR                                                       J508P2   841
                IF (KOUNTER .NE. 1 ) GO TO 6060                                         J508P2   842
                WRITE(IY,1980)                                                          J508P2   843
                WRITE(IY,1990)                                                          J508P2   844
                WRITE(IY,2300)                                                          J508P2   845
      845       6060 CONTINUE                                                           J508P2   846
                ICKCGT=KPRESS                                                           J508P2   847
                IF (ICKCGT.LE.1)GO TO 1890                                              J508P2   848
                IF (ICKCGT.GE.2)GO TO 1880                                              J508P2   849
                GO TO (1890,1880),ICKCGT                                                J508P2   850
      850       1880 BPADP=100.*BPADP                                                   J508P2   851
                BERR=100.*BERR                                                          J508P2   852
                WRITE(IY,2310)II,JJ,BPADP,III,JJJ,BERR                                  J508P2   853
     1890       ICKCGT=KINERT                                                           J508P2   854
                IF (ICKCGT.LE.1)GO TO 1910                                              J508P2   855
      855       IF (ICKCGT.GE.2)GO TO 1900                                              J508P2   856
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                GO TO (1910,1900),ICKCGT                                    J508P2  857
             1900 BARDT=100.*BARDT                                          J508P2  858
                  BARDR=100.*BARDR                                          J508P2  859
                  WRITE(IY,2320)BARDT,BARDR                                 J508P2  860
A60          1910 ICKCGT=KFRIC                                              J508P2  861
                  IF (ICKCGT.LE.1)GO TO 1930                                J508P2  862
                  IF (ICKCGT.GE.2)GO TO 1920                                J508P2  863
                  GO TO (1930,1920),ICKCGT                                  J508P2  864
             1920 WRITE(IY,2330)                                            J508P2  865
A65          1930 WRITE(IY,2340)                                            J508P2  866
                  WRITE(IY,2350)RC,THETC,QC2,TFT                            J508P2  867
                  MFLAG= 0                                                  J508P2  868
                  IF ( KOUNTER .EQ. 1) GO TO 4000                           J508P2  869
                C  **  CHECK FOR CONVERGENCE OF AXIAL FORCE                 J508P2  870
A70               IF ( ABS( (TFT - OLDTFT) / TFT ) .LE. TOLERC ) MFLAGF= 1  J508P2  871
             4000 OLDTFT= TFT                                               J508P2  872
                  WRITE(IY,2360)QR2,QRM1,FM1,FM0,FW1                        J508P2  873
                  WRITE(IY,2340)                                            J508P2  874
                C                                                           J508P2  875
A75             C     WRITE ONTO TAPE 64 FOR BOSS1                          J508P2  876
                      ML1=M-1                                               J508P2  877
                      CALL MEMSET ( AREA, AREA(MN), 0. )                    J508P2  878
                      NL1QQ= N - 1                                          J508P2  879
                      DO 1931 NC= 2, NL1QQ                                  J508P2  880
A80                   DO 1931 MC=2,ML1                                      J508P2  881
                      I= N*(MC-1)+NC                                        J508P2  882
                      AREA(I)=(((R(MC+1)+R(MC))/2.)**2-((R(MC)+R(MC-1))/2.)**2)*  J508P2  883
                     1 ( THETA(NC+1) - THETA(NC-1) ) / 4.                   J508P2  884
                 1931 CONTINUE                                              J508P2  885
A85             C                                                           J508P2  886
                C ** NET PRESSURE ON BOUNDARY IS ALWAYS 0.--AREAS ARE NOT NEEDED  J508P2  887
                C                                                           J508P2  888
                      REWIND 64                                             J508P2  889
                      DO 1933 NC=1,N                                        J508P2  890
A90                   DO 1933 MC=1,M                                        J508P2  891
                      I= N*(MC-1)+NC                                        J508P2  892
                 1933 PT(I)=P(MC,NC)-AMBP                                   J508P2  893
                      BOSMN=MN                                              J508P2  894
                      WRITE(64,1935) BOSMN                                  J508P2  895
A95                   DO 1934 NC=1,N                                        J508P2  896
                      DO 1934 MC=1,M                                        J508P2  897
                      I= N * (MC - 1 ) + NC                                 J508P2  898
                      FO(I)= AREA(I) * PT(I)                                J508P2  899
                      BOSI=  (N + NBARQQ) * (MC - 1) + NC                   J508P2  900
A00                   IF (NTRANS(1,1) .NE. 0 ) BOSI= NTRANS(MC,NC)          J508P2  901
                      WRITE(64,1935) BOSI,FO(I)                             J508P2  902
                 1935 FORMAT (F7.0,14X,F7.4)                                J508P2  903
                 1934 CONTINUE                                              J508P2  904
                      REWIND 64                                             J508P2  905
A05                   IF (1.GT.M)GO TO 355                                  J508P2  906
                      DO 1970 I=1,M                                         J508P2  907
                      WRITE(IY,2370)I                                       J508P2  908
                      WRITE(IY,2380)                                        J508P2  909
                      DO 1970 J=1,N,2                                       J508P2  910
A10                   REH=(WBAR(I,J)*RHO*H(I,J))/U9                         J508P2  911
                      RET=(UBAR(I,J)*RHO*H(I,J))/U9                         J508P2  912
                      IF (J-N)1950,1940,1950                                J508P2  913
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      1940 JJ=0                                                                  J508P2   914
           PP=0.                                                                 J508P2   915
  915      UU=0.                                                                 J508P2   916
           WW=0.                                                                 J508P2   917
           RR=0.                                                                 J508P2   918
           CC=0.                                                                 J508P2   919
           RET1=0.                                                               J508P2   920
  920      RER1=0.                                                               J508P2   921
           GO TO 1960                                                            J508P2   922
      1950 JJ=J+1                                                                J508P2   923
           PP=P(I,J+1)                                                           J508P2   924
           UU=UBAR(I,J+1)                                                        J508P2   925
  925      WW=WBAR(I,J+1)                                                        J508P2   926
           RR=RE(I,J+1)                                                          J508P2   927
           CC=CODE(I,J+1)                                                        J508P2   928
           RET1=(UBAR(I,J+1)*RHO*H(I,J+1))/U9                                    J508P2   929
           RER1=(WBAR(I,J+1)*RHO*H(I,J+1))/U9                                    J508P2   930
  930      1960 ZOT=FMAT(CODE(I,J))                                              J508P2   931
           ZOT1=FMAT(RET1)                                                       J508P2   932
           ZOT2=FMAT(RER1)                                                       J508P2   933
           ZOT3=FMAT(RR)                                                         J508P2   934
           ZOT4=FMAT(CC)                                                         J508P2   935
  935      ZOT5=FMAT(RET)                                                        J508P2   936
           ZOT6=FMAT(RER)                                                        J508P2   937
           ZOT7=FMAT(RE(I,J))                                                    J508P2   938
           WRITE(IY,2390)J,P(I,J),UBAR(I,J),WBAR(I,J),ZOT5,ZOT6,ZOT7,            J508P2   939
          +ZOT,JJ,PP,UU,WW,ZOT1,ZOT2,ZOT3,ZOT4                                   J508P2   940
  940      1970 CONTINUE                                                         J508P2   941
           355 CONTINUE                                                          J508P2   942
           REWIND 62                                                             J508P2   943
           REWIND 63                                                             J508P2   944
           999 CONTINUE                                                          J508P2   945
  945      C                                                                     J508P2   946
           1980 FORMAT (43H1 HYDRODYNAMIC THRUST BEARING PROGRAM 508-1,//)       J508P2   947
           1990 FORMAT (1X,71H                                                   J508P2   948
          +                  )                                                  J508P2   949
           2000 FORMAT (6E12.3)                                                  J508P2   950
  950      2010 FORMAT (1H )                                                     J508P2   951
           2020 FORMAT (120H   PAD INSIDE RADIUS  PAD OUTSIDE RADIUS            D J508P2   952
          +ENSITY          VISCOSITY    MINIMUM PRESSURE    AMBIENT PRESSURE    J508P2   953
          +)                                                                     J508P2   954
           2030 FORMAT (6E20.6/)                                                 J508P2   955
  955      2040 FORMAT (120H    TURB. CONSTANT K  CRIT. REYNOLDS NO.        ERROR J508P2   956
          + LIMIT      PAD SPAN ANGLE        RELAX FACTOR   MINIMUM NO. ITER.  J508P2   957
          +)                                                                     J508P2   958
           2050 FORMAT (6E20.6/)                                                 J508P2   959
           2060 FORMAT (120H    ROTATIONAL SPEED     PIVOT COORD.  R  PIVOT COORD. J508P2   960
  960     + THETA    PAD RADIAL SLOPE  PAD TANGENT. SLOPE     PIVOT CLEARANCE   J508P2   961
          +)                                                                     J508P2   962
           2070 FORMAT (18I4)                                                    J508P2   963
           2080 FORMAT (120H R ROWS T COLS  LIM.P  PRT M READ O READ P READ T READ J508P2   964
          + R READ N READ C READ S READ H   FLOW INERT.  LIM.I  COUP. READ CA   J508P2   965
  965     +)                                                                     J508P2   966
           2090 FORMAT (1717///)                                                 J508P2   967
           2100 FORMAT (6E12.3)                                                  J508P2   968
           2110 FORMAT (120H    ORIFICE DIAMETER    FLOW COEFFICIENT SPECIFIC HEAT J508P2   969
          + RATIO     SUPPLY PRESSURE      GAS CONSTANT-R      GAS CONSTANT-T  J508P2   970
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0 0 5 0 0 6 2

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      +,/6E20.5/)                                                                J508P2   971
 2120 FORMAT (3E12.3)                                                            J508P2   972
 2130 FORMAT (60H  CAPILLARY DIAMETER    CAPILLARY LENGTH     SUPPLY PRE        J508P2   973
     +SSURE,/3F20.5/)                                                           J508P2   974
 2140 FORMAT (2I5,E12.3,I5,I2)                                                  J508P2   975
 2150 FORMAT (15X,21H THETA VALUES READ IN,//)                                  J508P2   976
 2160 FORMAT (10F7.2)                                                           J508P2   977
 2170 FORMAT (15X,21H RADII VALUES READ IN,//)                                  J508P2   978
 2180 FORMAT (6E12.3)                                                           J508P2   979
 2190 FORMAT (100H      NUTATION ANGLE   NUTATION VELOCITY PRECESSION VE        J508P2   980
     +LOCITY      AXIAL VELOCITY    ANGLE MIN.CLEAR.)                          J508P2   981
 2200 FORMAT (5E20.6//)                                                         J508P2   982
 2210 FORMAT (E12.3,I5)                                                         J508P2   983
 2220 FORMAT (25H RADIUS OF CURVATURE CODE)                                     J508P2   984
 2230 FORMAT (E20.6,I5/)                                                        J508P2   985
 2240 FORMAT (2E12.3,I5)                                                        J508P2   986
 2250 FORMAT (32H  PAD STEP DEPTH  PAD STEP ANGLE,/E16.5,E16.5,I5/)             J508P2   987
 2260 FORMAT (6E12.3)                                                           J508P2   988
 2270 FORMAT (2I5,E12.3,I2,I6 )                                                 J508P2   989
 2280 FORMAT (120H0   J    CLEARANCE     PRESSURE CODE          J    CLEA      J508P2   990
     +RANCE     PRESSURE CODE          J    CLEARANCE     PRESSURE CODE       J508P2   991
     +)                                                                         J508P2   992
 2290 FORMAT (I5,2E13.5,I5,5X,I5,2E13.5,I5,5X,I5,2E13.5,I5)                     J508P2   993
 2300 FORMAT (1H0,///)                                                          J508P2   994
 2310 FORMAT (34H ITERATIONS ARE AT LIMIT--POINT I=,I5,3H J=,I5,29H HAS         J508P2   995
     +LARGEST PER CENT ERROR =,E12.5/25X,9H POINT I=,I5,3H J=,I5,37H HAS        J508P2   996
     + LARGEST EXTRAPOLATED AVE. ERROR=,E12.5//)                                J508P2   997
 2320 FORMAT (47H INERTIA ITERATIONS ARE AT LIMIT--AVE.DELTA FT=,F8.2,8H         J508P2   998
     + PERCENT,17H    AVE.DELTA FR=,F8.2,8H PERCENT,//)                         J508P2   999
 2330 FORMAT (60H ITERATIONS FOR VSTAR AT LIMIT FRICTION CALCULATIONS DE        J508P2  1000
     +LETED,/////)                                                              J508P2  1001
 2340 FORMAT (119H * * * * * * * * * * * * * * * * * * * * * * * * * * * *     J508P2  1002
     + * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * ,    J508P2  1003
     +/)                                                                        J508P2  1004
 2350 FORMAT (120H      RADIAL CENTER OF PRESSURE    ANGULAR CENTER OF PR      J508P2  1005
     +ESSURE              FLOW RATE COLUMN 2                  AXIAL FORCE       J508P2  1006
     +,/120H                (INCHES)                  (DEGREES)                J508P2  1007
     +                  (CU.IN./SEC.)                    (LB)    ,/4F30       J508P2  1008
     +.5/)                                                                      J508P2  1009
 2360 FORMAT (120H          FLOW RATE ROW 2      FLOW RATE ROW(M-1)   SLI      J508P2  1010
     +DER FRICTION MOMENT   BEARING FRICTION MOMENT       FRICTION POWER       J508P2  1011
     +,/120H           (CU.IN/SEC.)              (CU.IN./SEC.)            (     J508P2  1012
     +IN.LB)                    (IN.LB)                  (WATTS)    ,/2F24       J508P2  1013
     +.5,F25.5,F26.5,F21.5/)                                                    J508P2  1014
 2370 FORMAT (5H  I =,I2)                                                       J508P2  1015
 2380 FORMAT (119H     J       P     U(M)     W(M)    RE(T)    RE(R)       RE  J508P2  1016
     +CODE      J       P     U(M)     W(M)    RE(T)    RE(R)       RE CODE)  J508P2  1017
 2390 FORMAT (I5,3F8.2,3F8.0,F5.0,3X,I5,3F8.2,3F8.0,F5.0)                       J508P2  1018
      END                                                                       J508P2  1019
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CARD NR. SEVERITY DETAILS DIAGNOSIS OF PROBLEM

128 I AN IF STATEMENT MAY BE MORE EFFICIENT THAN A 2 OR 3 BRANCH COMPUTED GO TO STATEMENT.
144 I AN IF STATEMENT MAY BE MORE EFFICIENT THAN A 2 OR 3 BRANCH COMPUTED GO TO STATEMENT.



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| CARD NR. | SEVERITY | DETAILS | DIAGNOSIS OF PROBLEM |
|---|---|---|---|
| 151 | I | | AN IF STATEMENT MAY BE MORE EFFICIENT THAN A 2 OR 3 BRANCH COMPUTED GO TO STATEMENT. |
| 159 | I | | AN IF STATEMENT MAY BE MORE EFFICIENT THAN A 2 OR 3 BRANCH COMPUTED GO TO STATEMENT. |
| 164 | I | | AN IF STATEMENT MAY BE MORE EFFICIENT THAN A 2 OR 3 BRANCH COMPUTED GO TO STATEMENT. |
| 192 | I | | AN IF STATEMENT MAY BE MORE EFFICIENT THAN A 2 OR 3 BRANCH COMPUTED GO TO STATEMENT. |
| 212 | I | | AN IF STATEMENT MAY BE MORE EFFICIENT THAN A 2 OR 3 BRANCH COMPUTED GO TO STATEMENT. |
| 224 | I | | AN IF STATEMENT MAY BE MORE EFFICIENT THAN A 2 OR 3 BRANCH COMPUTED GO TO STATEMENT. |
| 240 | I | | AN IF STATEMENT MAY BE MORE EFFICIENT THAN A 2 OR 3 BRANCH COMPUTED GO TO STATEMENT. |
| 253 | I | | AN IF STATEMENT MAY BE MORE EFFICIENT THAN A 2 OR 3 BRANCH COMPUTED GO TO STATEMENT. |
| 264 | I | | AN IF STATEMENT MAY BE MORE EFFICIENT THAN A 2 OR 3 BRANCH COMPUTED GO TO STATEMENT. |
| 274 | I | | AN IF STATEMENT MAY BE MORE EFFICIENT THAN A 2 OR 3 BRANCH COMPUTED GO TO STATEMENT. |
| 306 | I | | AN IF STATEMENT MAY BE MORE EFFICIENT THAN A 2 OR 3 BRANCH COMPUTED GO TO STATEMENT. |
| 313 | I | | AN IF STATEMENT MAY BE MORE EFFICIENT THAN A 2 OR 3 BRANCH COMPUTED GO TO STATEMENT. |
| 350 | I | | AN IF STATEMENT MAY BE MORE EFFICIENT THAN A 2 OR 3 BRANCH COMPUTED GO TO STATEMENT. |
| 450 | I | | AN IF STATEMENT MAY BE MORE EFFICIENT THAN A 2 OR 3 BRANCH COMPUTED GO TO STATEMENT. |
| 534 | I | | AN IF STATEMENT MAY BE MORE EFFICIENT THAN A 2 OR 3 BRANCH COMPUTED GO TO STATEMENT. |
| 849 | I | | AN IF STATEMENT MAY BE MORE EFFICIENT THAN A 2 OR 3 BRANCH COMPUTED GO TO STATEMENT. |
| 856 | I | | AN IF STATEMENT MAY BE MORE EFFICIENT THAN A 2 OR 3 BRANCH COMPUTED GO TO STATEMENT. |
| 863 | I | | AN IF STATEMENT MAY BE MORE EFFICIENT THAN A 2 OR 3 BRANCH COMPUTED GO TO STATEMENT. |



82500

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      OVERLAY (FILE0, 1, 0 )                                                    TRDATA      2
      PROGRAM TRDATA                                                            TRDATA      3
C                                                                               TRDATA      4
C                                                                               TRDATA      5
C  TAPE62 -- HYDRODYNAMIC PROGRAM FIXED INPUT                                   TRDATA      6
C         REWIND AGAIN AND AGAIN                                                TRDATA      7
C                                                                               TRDATA      8
C  TAPE63 -- BOSS1 FIXED GEOMETRIC DATA INPUT                                   TRDATA      9
C         REWIND AGAIN AND AGAIN                                                TRDATA     10
C                                                                               TRDATA     11
C  TAPE64 -- BOSS1 FORCE B.C. INPUT (HYDRODYNAMICS OUTPUT)                      TRDATA     12
C         FOR ITERATION-READ BY BOSS1-GENERATED BY HYDRODYNAMICS                TRDATA     13
C                                                                               TRDATA     14
C  TAPE65 -- BOSS1 Z-DISPLACEMENT OUTPUT (HYDRODYNAMICS INPUT)                  TRDATA     15
C         FOR ITERATION-READ BY HYDRODYNAMICS-GENERATED BY BOSS1                TRDATA     16
C                                                                               TRDATA     17
C                                                                               TRDATA     18
      DIMENSION F(10),H(21,21),THETA(21),UZ(441),P(21,21),IP(21,21)             TRDATA     19
      DIMENSION NTRANS(21,21)                                                   TRDATA     20
      DATA IX/60/,IY/61/,II/62/,IJ/63/,IK/64/,IL/65/                            TRDATA     21
      WRITE(IY,100)                                                             TRDATA     22
  100 FORMAT(1H1//)                                                             TRDATA     23
      REWIND II                                                                 TRDATA     24
      REWIND IJ                                                                 TRDATA     25
      REWIND IK                                                                 TRDATA     26
      REWIND IL                                                                 TRDATA     27
      READ (IX,1990) (F(I),I=1,10)                                              TRDATA     28
      WRITE(II,1990) (F(I),I=1,10)                                              TRDATA     29
      WRITE(IY,1990) (F(I),I=1,10)                                              TRDATA     30
 1990 FORMAT(10A8)                                                              TRDATA     31
      READ (IX,2000)RR1,RRM,RHO,U9,VAPP,AMBP,CONK,RECR,ERRDP,PANG,RELAX,        TRDATA     32
     1EXT                                                                       TRDATA     33
      WRITE(II,2000)RR1,RRM,RHO,U9,VAPP,AMBP,CONK,RECR,ERRDP,PANG,RELAX,        TRDATA     34
     1EXT                                                                       TRDATA     35
      WRITE(IY,2001)RR1,RRM,RHO,U9,VAPP,AMBP,CONK,RECR,ERRDP,PANG,RELAX,        TRDATA     36
     1EXT                                                                       TRDATA     37
      READ (IX,7766)S,RP,TP,PHIR,PHIT,HP, NBARQQ                                TRDATA     38
 7766 FORMAT (6E12.3, 6X, I2 )                                                  TRDATA     39
      WRITE(II,7766)S,RP,TP,PHIR,PHIT,HP, NBARQQ                                TRDATA     40
      WRITE (IY,7767) NBARQQ                                                    TRDATA     41
 7767 FORMAT ( 6HONBAR=   I4 )                                                  TRDATA     42
      WRITE(IY,2001)S,RP,TP,PHIR,PHIT,HP                                        TRDATA     43
 2000 FORMAT(6E12.3)                                                            TRDATA     44
      READ (IX,2070)M,N,LP,MPRT,IRO,IRP,IRT,IRR,IRN,IRC,IRS,IRH,INC,INER        TRDATA     45
     1T,LI,ICEC,ICAP,ICHAM                                                      TRDATA     46
      WRITE(II,2070)M,N,LP,MPRT,IRO,IRP,IRT,IRR,IRN,IRC,IRS,IRH,INC,INER        TRDATA     47
     1T,LI,ICEC,ICAP,ICHAM                                                      TRDATA     48
      WRITE(IY,2071)M,N,LP,MPRT,IRO,IRP,IRT,IRR,IRN,IRC,IRS,IRH,INC,INER        TRDATA     49
     1T,LI,ICEC,ICAP,ICHAM                                                      TRDATA     50
 2070 FORMAT(18I4)                                                              TRDATA     51
      IF(IRO.NE.1) GO TO 111                                                    TRDATA     52
      READ (IX,2000)AD,CD,SHR,PS,RGAS,TGAS                                      TRDATA     53
      WRITE(II,2000)AD,CD,SHR,PS,RGAS,TGAS                                      TRDATA     54
      WRITE(IY,2001)AD,CD,SHR,PS,RGAS,TGAS                                      TRDATA     55
  111 CONTINUE                                                                  TRDATA     56
      IF(IRP.NE.1) GO TO 113                                                    TRDATA     57
      NEXT=1                                                                    TRDATA     58
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                DO 115 I=1,M                                                    TRDATA     59
                DO 115 J=1,N                                                    TRDATA     60
   60           P(I,J)=AMBP                                                     TRDATA     61
                IF(IRO.EQ.1) P(I,J)=PS                                          TRDATA     62
                IP(I,J)=0                                                       TRDATA     63
                IF(J.EQ.1.OR.J.EQ.N) IP(I,J)=1                                  TRDATA     64
                IF(I.EQ.1.OR.I.EQ.M) IP(I,J)=1                                  TRDATA     65
   65           IF(I.EQ.M.AND.J.EQ.N) NEXT=2                                    TRDATA     66
                WRITE(II,2140) (I,J,P(I,J),IP(I,J),NEXT)                        TRDATA     67
             2140 FORMAT(2I5,E12.5,I5,I2)                                       TRDATA     68
                WRITE(IY,2141)  (I,J,P(I,J),IP(I,J),NEXT)                       TRDATA     69
              115 CONTINUE                                                      TRDATA     70
   70         113 CONTINUE                                                      TRDATA     71
                IF(IRT.NE.1) GO TO 112                                          TRDATA     72
                READ (IX,2160) (THETA(J),J=1,N)                                 TRDATA     73
                WRITE(II,2160) (THETA(J),J=1,N)                                 TRDATA     74
             2160 FORMAT(10F7.2)                                                TRDATA     75
   75           WRITE(IY,2161)(THETA(J),J=1,N)                                  TRDATA     76
              112 CONTINUE                                                      TRDATA     77
                IF(IRS.NE.1) GO TO 123                                          TRDATA     78
                READ(IX,2240) PSD,PSA,ISTEP                                     TRDATA     79
             2240 FORMAT(2E12.5,I5)                                             TRDATA     80
   80           WRITE(II,2240) PSD,PSA,ISTEP                                    TRDATA     81
                WRITE(IY,2241) PSD,PSA,ISTEP                                    TRDATA     82
              123 CONTINUE                                                      TRDATA     83
                IF(IRH.NE.1) GO TO 114                                          TRDATA     84
             1101 READ (IX,2270) I, J, H(I,J), NEXT, NTRANS(I,J)                TRDATA     85
   85           WRITE(II,2270) I, J, H(I,J), NEXT, NTRANS(I,J)                  TRDATA     86
                WRITE(IY,2271) I, J, H(I,J), NEXT, NTRANS(I,J)                  TRDATA     87
             2270 FORMAT (2I5,E12.3,I2,I6 )                                     TRDATA     88
                IF(NEXT.LE.1) GO TO 1101                                        TRDATA     89
              114 READ (IX,2000) QQQIN                                          TRDATA     90
   90           IF ( EOF(IX) ) 12345,12346                                      TRDATA     91
            12345 QQQIN= .040                                                   TRDATA     92
                PRINT 2001, QQQIN                                               TRDATA     93
                GO TO 120                                                       TRDATA     94
            12346 PRINT 2001, QQQIN                                             TRDATA     95
   95       C                                                                   TRDATA     96
            C     PICK UP BOSS; DATA -- NEXT CARD MUST BE AN EOR                TRDATA     97
                READ (IX,1990) F                                                TRDATA     98
                IF (EOF(IX)) 120,110                                            TRDATA     99
              110 WRITE (61,4000)                                               TRDATA    100
  100          4000 FORMAT (33H0REARING DATA NOT FOLLOWED BY EOR    )           TRDATA    101
                IF (F(1) .EQ. 10HSTIFFNES       ) GO TO 130                     TRDATA    102
                WRITE (61,1992) F                                               TRDATA    103
                STOP                                                            TRDATA    104
              120 READ (IX,1990) F                                              TRDATA    105
  105           IF (EOF(IX)) 140,130                                            TRDATA    106
              130 WRITE (IJ,1990) F                                             TRDATA    107
                WRITE (61,1992) F                                               TRDATA    108
             1992 FORMAT ( 1X, 10A8 )                                           TRDATA    109
                GO TO 120                                                       TRDATA    110
  110       C                                                                   TRDATA    111
            C     CHECK FOR Z-DISPLACEMENT DATA                                 TRDATA    112
            C                                                                   TRDATA    113
              140 READ (IX,210) I, UZ(I)                                        TRDATA    114
                IF ( EOF(IX)) 170,150                                           TRDATA    115
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      150 WRITE (IL,210) I, UZ(1)                                    TRDATA   116
          WRITE (61,219) I, UZ(1)                                    TRDATA   117
      160 READ (IX,210) I, UZ(1)                                     TRDATA   118
          IF ( EOF(IX)) 208,150                                      TRDATA   119
C                                                                    TRDATA   120
C     NO DATA -- ASSUME ALL UZ= 0.                                   TRDATA   121
C                                                                    TRDATA   122
      170 CONTINUE                                                   TRDATA   123
          MN=M*N                                                     TRDATA   124
          DO 200 I=1,MN                                              TRDATA   125
          UZ(I)=0.                                                   TRDATA   126
          WRITE(IL,210) I,UZ(I)                                      TRDATA   127
      210 FORMAT ( 1X, I5, F14.8)                                    TRDATA   128
          WRITE(IY,219) I,UZ(I)                                      TRDATA   129
      200 CONTINUE                                                   TRDATA   130
     1991 FORMAT(1X,8A10)                                            TRDATA   131
     2001 FORMAT(1X,6E12.3)                                          TRDATA   132
     2071 FORMAT(1X,18I4)                                            TRDATA   133
     2141 FORMAT(1X,2I5,E12.5,I5,I2)                                 TRDATA   134
     2161 FORMAT(1X,10F7.2)                                          TRDATA   135
     2241 FORMAT(1X,2E12.5,I5)                                       TRDATA   136
     2271 FORMAT ( 1X,2I5,E12.3,I2,I6 )                              TRDATA   137
      219 FORMAT(1X,I6,F14.6)                                        TRDATA   138
C                                                                    TRDATA   139
C                                                                    TRDATA   140
      208 WRITE (II,2000) QQQIN                                      TRDATA   141
C                                                                    TRDATA   142
          END                                                        TRDATA   143
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